Variations in Behaviour Function in Individuals with Intellectual Disability and Psychotropic Medication

by

Alison Cox

A Thesis submitted to the Faculty of Graduate Studies of The University of Manitoba

in partial fulfilment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

University of Manitoba

Winnipeg

ACKNOWLEDGMENTS

I would like to thank my advisor Dr. Javier Virues-Ortega for his ongoing support, guidance and mentorship throughout my dissertation. I would also like to thank my committee members, Drs. Dickie Yu, Joseph Pear, Beverly Temple, and Toby Martin, and my External Examiner, Dr. Erik Arntzen (Akershus University College) for their suggestions and feedback. To Dr. Vicki Isler, and the staff, parents and participants at Lifescape, I could not have done it without you. Your commitment and dedication to this project was invaluable. To my Winnipeg contingent, participants, parents, research assistants, and the St. Amant Research Center; your support was instrumental. Finally, to my fiancé Michael Martins, who was my IT support, data mining specialist, and biggest fan, thank you!

This project was funded by grants from the Manitoba Health Research Council and Manitoba Institute for Child Health.

Abstract

Psychopharmacological and behavioural interventions are used to treat challenging behaviours (e.g., self-injury, aggression, stereotypy, bizarre vocalizations) in individuals with intellectual disability (ID), often in combination. However, little is known about the behavioural mechanisms underlying psychopharmacological treatment. Establishing a better understanding of these mechanisms could contribute to improving treatment efficacy. For this study, I conducted repeated functional analyses using single-subject experimental designs to assess the impact of naturally varying dosages of psychotropic medications on behaviour function. Four individuals with ID who engaged in challenging behaviour and were undergoing psychotropic medication changes participated. Medication impact across two topographies for one participant, and three topographies for another participant were assessed, for a total of seven cases. For Analysis 1, I calculated standardized mean differences between baseline and final drug administration phases to estimate the overall effect of medication. I used this information to examine whether response rate following drug administration was related to response rate during baseline, referred to as rate-dependency. Rate-dependency was not observed. Analysis 2 explored the relation between psychotropic medications and behaviour function identified through functional analyses. Challenging behaviour was the dependent variable, while functional analysis conditions and psychotropic medication level served as independent variables. The latter was a quasi-experimental variable given participants' psychiatric team prescribed changes independent of the researchers. Behaviour function correspondence, defined as no function change after a medication manipulation, was observed across 14 of the 21 medication manipulations (67%).

Keywords: Psychotropic Medications, Intellectual Disability, Functional Analysis, Rate-Dependency

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Variation in Behaviour Function in Individuals with Intellectual Disability and Psychotropic Medication

Between 16% and 50% of individuals with intellectual disability (ID) engage in aggression and self-injury (Myrbakk & von Tetzchner, 2008; Qureshi & Alboiz, 1992; Smith, Russo, & Le, 1999). Other examples of challenging behaviours include stereotypy, bizarre vocalizations, and property destruction. All of these behaviours interfere with skill acquisition, access to services, and ultimately disrupt daily life activities (Felce, Lowe, Beecham & Hallam, 2000). In fact, Felce et al. (2000) explored the relationships between individual characteristics and quality of life outcomes through a series of multivariate regression analyses. They found that severe challenging behaviour accurately predicted lower community involvement and overall level of adaptive behaviour.

Treating challenging behaviours typically involves behavioural, psychopharmacological, or combined interventions (Heyvaert, Mase & Onghena, 2010; Matson & Dempsey, 2008). Some behaviour analytic research has examined the relative effectiveness of combined versus unimodal interventions (Blum, Mauk, McComas & Mace, 1996; Northup et al., 1999; Pelham, et al., 2000; Pelham et al., 1993). For example, an early study by Fisher, Piazza, and Page (1989) assessed three challenging behaviours displayed by one individual with ID, including: aggression, disruption, and psychotic verbalization. Response rate was assessed when pharmacological and behavioural interventions were implemented in isolation, as well as in combination. The authors found that the rate of psychotic speech was lowest when combined behavioural and pharmacological interventions were implemented. By contrast, the frequency of disruptive and aggressive behaviours remained variable at higher dosages. In fact, medication was discontinued due to substantial increases in aggressive and disruptive behaviours. When

medication was discontinued and behavioural interventions were implemented in isolation, challenging behaviour reduced to near zero levels. Fisher et al. (1989) demonstrated that both unimodal and combined interventions were successful in reducing specific target behaviours (e.g., psychotic speech; aggressive and disruptive behaviour).

More recently, some large-scale group design studies have evaluated combined versus unimodal interventions (Capriotti, Brandt, Ricketts, Espil & Woods, 2012; Frazier et al., 2010; Rodrigues, Thompson, Schlichenmeyer & Stocco, 2012). Scahill et al. (2011) conducted a 24-week, multisite randomized clinical trial. Children ages 4-13 years with ID and challenging behaviours were enrolled in either a medication alone group (risperidone) or a combination of medication plus parent training on behavioural strategies. Both groups of children improved in adaptive skills over the duration of the study. However, those in the combination group showed modest additional benefits over the medication alone group in the form of slightly higher adaptive skill development and slightly lower instances of challenging behaviour.

Current literature suggests that psychopharmacological interventions as a unimodal approach may differentially affect challenging behaviour across and within participants (Blum et al., 1996; Fisher et al., 1989; Tyrer et al., 2008). In addition, there has been a substantial increase in the dissemination of reinforcement-based approaches designed to assess and treat challenging behaviour (Grey & Hastings, 2005). Despite this, a heavy clinical reliance on psychopharmacological interventions persists (Aman, Lam, & VanBourgondien, 2005; Feldman, Atkinson, Foti-Gervais, & Condillac, 2004; Myers, 2007). Improving our knowledge of the behavioural mechanisms involved in treatment gains could lead to a better understanding of which treatment packages yield better outcomes under specific circumstances. This information could be used to help shape clinical practice.

1.1 Psychotropic Medications and Challenging Behaviour

Psychotropic medications are chemical substances that cross the blood-brain barrier, act upon the central nervous system and alter mood, thought processes, and behaviour (Julien, 1995). There are many different kinds of psychotropic medications including antidepressants, stimulants, and antipsychotics. These medications can exert a range of pharmacodynamic, therapeutic, and side effects (see Table 1), and are therefore used to address an array of psychiatric conditions including psychotic, mood, and anxiety disorders, among others (Julien, 1995).

Table 1

Characteristics of psychotropic medications

Medication	Elimination Half-Life	Pharmacodynamic Effect	Side effects
Aripiprazole*	75 – 96 hrs	Partial dopamine agonist with a high affinity for D_2 and D_3 receptors.	Weight gain; Headache; Agitation; Insomnia; Anxiety; Nausea/Vomiting; Akathisia; Constipation
Clonidine**	9 – 12 hrs	Selective agonist for $alpha_2$	Hypotension, Bradycardia, and Drowsiness.
Fluoxetine***	24 - 96 hrs	Inhibits active presynaptic serotonin reuptake.	Nervousness, Anxiety, Insomnia, Nausea, Motor restlessness, Muscle rigidity
Risperidone*	3 - 21 hrs	Inhibitor of $dopamine_2$ and $serotonin_2$ receptors.	Agitation; Anxiety; Insomnia; Headache; Extrapyramidal effects; Nausea; Sedation; Weight gain
Methylphenidate***	2 – 3 hrs	Indirectly acting catecholamine agonists; cause the release of newly synthesized norepinephrine and dopamine from presynaptic nerve terminals	Decreased appetite, Insomnia, Headache, Stomach ache

Note: * From Mathews & Muzina, 2007; ** From Miyamoto, Duncan, Marx & Lieberman , 2005; *** From Julien, 1995

These qualities also promote their use in addressing mental illness and corresponding challenging behaviours in persons with ID. However, correctly identifying and diagnosing mental illness in individuals with ID, and treating them accordingly, can be difficult (Leyfer et al., 2006). Specifically, persons with ID may engage in behaviours that differ from the standard symptoms present in typically developed clients with mental illness. Moreover, many persons with ID cannot communicate thoughts or feelings often associated with specific psychiatric disorders (e.g., paranoid thoughts, suicidal ideation, obsessions) (Lord & Paul, 1997). Therefore, clinicians frequently attend to particular behaviours and behavioural changes that are assumed to suggest presence of a psychiatric condition (McDougle et al., 1995). For example, behaviours such as constant hair pulling and skin picking may be identified as behaviour associated with compulsions, and treated with medications recommended to alleviate obsessive-compulsive disorder (OCD). In the absence of specific behavioural patterns, some challenging behaviours may be identified as generalized behavioural disturbances and treated with atypical and typical antipsychotic medications (Aman, Lam & Collier-Crespin, 2003; Canadian Pharmacists Association, 2013; Gagiano, Read, Thorpe, Eerdekens, & Van Hove, 2005; Miral et al., 2008). In fact, antipsychotics have been prescribed to treat behavioural disturbances associated with dementia and OCD (Aman et al., 2003). These medications are among the most prevalent psychotropic prescription in persons with ID (Tsiouris, Kim, Brown, Pettinger, & Cohen, 2013). This could be in part because antipsychotic medications have sedative qualities, in addition to their 'antipsychotic effects' (see Table 1). Thus, for some cases clinicians may capitalize on these sedative qualities.

Alternatively, aantidepressants are often prescribed to treat depression, OCD, and panic disorders, (Firestone & Dozier, 2007), or in persons with ID behaviours hypothesized to

correspond with these diagnoses (Hollander et al., 2012). Stimulants are often prescribed to treat behaviours hypothesized to correspond with attention deficit hyperactivity disorders (ADHD) in persons with ID (Handen, Johnson & Lubetsky, 2000).

1.2 Functional Analysis and Challenging Behaviour

As mentioned above, pharmacology is not the only intervention approach available for the treatment of challenging behaviour in individuals with ID. In behavioural psychology, it is understood that the relations between behaviour and environmental factors are often called behaviour functions, and are crucial for understanding challenging behaviours as learned performances. There is an extensive corpus of evidence indicating that the function of the behaviour is central to the effects of treatment (Beavers, Iwata & Lerman, 2013). Researchers and clinicians therefore use the standard experimental methodology called a functional analysis to identify the environmental variables maintaining challenging behaviour.

During a functional analysis each individual is exposed to a series of experimental conditions while their behaviour is monitored through direct observation. Each condition differs along several dimensions. For example, the control or play condition presents zero task demands and has the instructor providing attention on a non-contingent basis while the individual has free access to preferred leisure items. This condition acts as a control because functional reinforcers are being presented non-contingently, which negates the individuals' need to engage in challenging behaviour to access preferred stimuli. Moreover, the individual is free to engage in self-stimulatory behaviour, and is not required to complete tasks; thereby eliminating the establishing operations for challenging behaviour. Conversely, in the social attention condition the participant is given a few moderately preferred items and the instructor provides attention contingent on the occurrence of challenging behaviour only. This condition tests for challenging

behaviour maintained by social positive reinforcement in the form of social attention. The alone condition requires the participant remain alone in a room without access to social, leisure or sensory stimuli. This condition can also be conducted when a therapist is present but does not interact with the participant. This 'no interaction' or 'ignore' condition is typically employed when it is not possible to record data without being in the room (e.g., no access to a room with a two-way mirror), or when assessing challenging behaviours that require another person to be present to occur (e.g., grabbing at others, hitting others, etc.). No consequences are provided contingent on challenging behaviour in this condition. In the demand condition the instructor repeatedly asks the participant to complete different tasks. The therapist provides short periods of escape from demands contingent on the participant engaging in challenging behaviour. This is done to assess whether behaviour is maintained by escape from demands. Rate of challenging behaviour, or the percentage interval responding is recorded during each condition. The condition where rate or percentage interval is the highest is posited as the variable that maintains the target behaviour.

A recent review of the functional analysis literature emphasizes its utility in the assessment and treatment of challenging behaviour (Beavers et al., 2013). Out of the 445 functional analyses analyzed, 91.7% revealed a clear behaviour function. This review also demonstrated the utility of functional analyses in a variety of clinical settings. For example, Tiger, Hanley, and Bessette (2006) incorporated care-provider feedback to develop individualized functional analysis conditions to assess behaviour function when standard functional analysis conditions did not accurately capture the environmental variables involved. Kodak, Grow and Northup (2004) assessed elopement in an outdoor setting. Elopement was defined as running more than 1 m away from the designated 'game area'. The authors

demonstrated the utility of a functional analysis in a more naturalistic setting. Setting modifications allowed them to more accurately capture the variables maintaining elopement. Finally, Richman and Hagopian (1999) modified functional analysis conditions, specifically the quality of the variable maintaining the behaviour. They conducted a standard functional analysis with two children with ID. Their initial analysis did not reveal a clear function. Therefore, the authors conducted a second functional analysis where they manipulated the quality of attention the children received contingent on challenging behaviour. This included verbal attention, physical attention, and exaggerated attention, and resulted in a clear discernable behaviour function. A function-based intervention was implemented and successfully reduced target behaviour to clinically significant levels.

Not only have the quality and type of reinforcer been adjusted, but duration of functional analysis conditions has also been manipulated to minimize assessment time, while preserving accuracy (e.g., brief functional analyses, latency-based functional analysis). Functional analysis research has varied the length of time an individual is exposed to a specific condition, from 1 minute (Northup et al., 1991) to 15 minutes per condition (O'Reilly & Lancioni, 2000). Beavers et al. (2013) reported 37.3% of the articles included in the review ran five minute functional analysis conditions. Conversely, 7% of the articles conducted 15 minute functional analysis condition sessions. Concerns about accurately identifying behaviour function when session length is decreased were addressed by Wallace and Iwata (1999). These researchers directly compared the functional analysis results of 5, 10, and 15 minute conditions. Forty-six individuals with ID participated in the study. The authors ran full 15 minute sessions for each individual. To compare 5, 10 and 15 minute outcomes, new data sets based on 10 and 5 minutes were prepared by simply removing the amount of time that applied and assessed behaviour function from the

new data. Their results indicated that all of the 10 minute sessions yielded interpretable data that was identical to 15 minute sessions. The results of the 5 and 15 minute session time yielded minimal differences. The authors concluded that minimal accuracy is lost when session time is reduced from 15 minutes to 5 minutes.

1.3 Evaluation of Motivating Operations in the Context of a Functional Analysis

Modifying functional analysis conditions has become a common practice as researchers and practitioners continue to further improve assessment effectiveness (Beavers et al., 2013). In addition to manipulating session duration and consequence variables, researchers have examined how adjusting antecedent variables may influence responding during the functional analysis (Berg et al., 2000; Kennedy & Meyer, 1996; O'Reilly, 1997). For example, motivating operations (MO) alter the effectiveness of a reinforcing or punishing stimulus (Michaels, 1982). Satiation and deprivation are classic examples of MOs. Repeated exposure to a reinforcer will gradually devaluate the functional role of the stimulus (satiation). Conversely, withholding access to a reinforcer may induce a temporary increment in the effectiveness of the reinforcer to motivate behaviour (deprivation). Satiation and deprivation can be easily evaluated in the laboratory and in applied settings by manipulating the time of exposure to the reinforcer (Berg et al., 2000; Edrisinha, O'Reilly, Sigafoos, Lancioni, & Choi, 2011). However, other MOs that do not involve any procedural manipulation of the reinforcer may exert similar effects upon behaviour including physiological processes such as sleep deprivation, and sensory stimuli, such as pain. For example, O'Reilly (1995) evaluated the interactions between sleep deprivation and behaviour function in the context of a functional analysis. The author operationally defined sleep deprivation as five hours of sleep or less per night, and had two care-providers independently record night sleep for the duration of the study. O'Reilly found that when the individual had five

hours of sleep or less the previous night, aggression frequency during the demand condition increased substantially, thus demonstrating a functional relation between sleep and escape-maintained challenging behaviour. Namely, sleep deprivation increased the punishing value of demands. In another example, Kennedy and Meyer (1996) conducted functional analyses of challenging behaviour in three individuals with ID monitoring periods with and without sleep deprivation or allergy symptoms. The authors found that the target behaviours were escape-maintained and were present only when the participants were sleep deprived or presented with allergy symptoms. Increased levels of attention-maintained challenging behaviours were also reported during periods of sleep deprivation and allergy symptoms. For one of the participants the presence of sleep deprivation altered the function of challenging behaviour. Specifically, when she was not sleep deprived her challenging behaviour was escape-maintained. By contrast, during periods of sleep deprivation challenging behaviour increased across all functional analysis conditions, which suggested that behaviour was sensory-maintained.

Sleep deprivation is one example of a number of variables that are not commonly considered during typical assessments but can influence functional analysis outcomes. Specifically, a range of bodily conditions including pain, food deprivation, and the pharmacological effects of psychotropic medications may affect the frequency of challenging behaviour in the context of a functional analysis (O'Reilly, 1995; O'Reilly, 1997, O'Reilly & Lancioni, 2000; Valdovinos, Nelson, Kuhle, & Dierks, 2009).

1. 3-1 Psychotropic medications as motivation operations.

Researchers have suggested that bodily conditions occasioned by the intake of psychotropic medications may be characterized as MOs, and may alter the reinforcing effects of other stimuli or interact with other operations known to evoke avoidance or escape (Crosland et

al., 2003; Danov, Tervo, Meyers & Symons, 2012; Northup et al., 1999). However, it remains a matter of debate whether psychotropic medications alter the pre-existing function of a target behaviour or alter neurobiological mechanisms (Crosland et al., 2003; Danov et al., 2012; Zarcone et al., 2004). The latter may be true, at least to some extent, among major sedative medications that are known to induce a widespread reduction across all behaviour repertoires presumably with little interaction with environmental events (see for instance Miral et al., 2008). In parallel to this effect, it may be possible that pharmacological effects alter the ability of the individual to engage in various behaviours or to respond to stimuli in ways that were previously reinforced. For example, qualitative studies on the subjective effects of antipsychotic medication collected reports of clients who "no longer enjoying doing anything" (from Carrick, Mitchell, Powell, & Lloyd, 2004; Larsen & Gerlach, 1996; Rogers et al., 1998). These descriptions are consistent with the view that psychotropic medications may be affecting the rate of certain behaviours possibly due to a devaluation of the reinforcers that used to follow these behaviours (abolishing operation). The evidence reviewed below illustrates that these effects can sometimes be identified by way of functional analyses.

1.4 Functional Analysis and Challenging Behaviour Exposed to Psychotropic Medication

A small number of studies have extended the use of functional analyses by investigating whether the form and function of challenging behaviour interact with the effects of stimulant medications (Northup et al., 1997a; Northup et al., 1999), opiate agonists (Garcia & Smith, 1999), some atypical antipsychotics (Danov et al., 2012; Valdovinos, Ellringer, & Alexander, 2007), and antidepressants (Valdovinos et al., 2009). Crosland et al. (2003) conducted a double-blind, placebo controlled study. One child and one adult participated. Challenging behaviour was recorded directly during each condition of the functional analysis (e.g., demand, tangible, alone,

play), and indirectly through common self-reported questionnaires including: the Aberrant Behavior Checklist (ABC; Aman et al., 1985), and the Clinical Global Impressions-Improvement (CGI; Guy, 1976). The authors found that risperidone decreased destructive behaviour during the demand condition for both participants. However, decreases in challenging behaviour during the access to tangible condition were not apparent. The authors suggested that risperidone may differentially affect escape-maintained challenging behaviour. Northup et al. (1999) provided further evidence for function-specific effects by showing that environmental conditions may interact with the presence or absence of methylphenidate (MPH). Specifically, the presence or absence of MPH altered response rates for some participants across modified functional analysis conditions. For example, disruptive behaviours occurred at high levels in alone and no-interaction conditions during the placebo condition. In the alone condition the student was by themselves in a room. In the no-interaction condition, a teacher remained at least 3 m from the student but did not attend to them irrespective of their behaviour. During the MPH condition disruptive behaviour remained high during the alone condition, but decreased to near zero levels in the no-interaction condition.

Zarcone et al. (2004) conducted a study that was similar to Crosland et al. (2003). However, some of their results contradicted earlier findings. Zarcone et al. examined the interaction between risperidone and the function of destructive behaviour in 13 participants with ID. Challenging behaviour was monitored through direct and indirect measures including functional analyses and ABC, respectively. The authors defined ‘responders’ as those who presented with 25% or more reduction in ABC-Irritability subscale scores after medication adjustment. Results indicated that risperidone was effective in reducing destructive behaviour

across several functional analysis conditions, including escape, for seven of the 10 responders. Thus, function-specific effects were not consistently observed.

1.4-1 A review on applied medication-behaviour interaction.

Overall research using functional analysis to evaluate the impact of psychotropic medications has not been extensive. In a recent review of research in this area, Cox and Virues-Ortega (in press) provided a detailed account of the most likely interactions between behaviour function and psychotropic medications. We reanalyzed existing data to evaluate: 1) the overall effects of psychotropic medications on challenging behaviour, and 2) medication-induced changes in behaviour function. A systematic literature review revealed 11 studies with 23 participants for a total of 37 participant datasets. The medications evaluated in this context included primarily antidepressants, antipsychotics, and stimulants. To examine the overall effects of psychotropic medications on challenging behaviour, we calculated standardized mean differences between baseline and final medication phases, or effect sizes to estimate the overall effect of medication for each participant dataset. We used the following formula:

$$ES = \frac{\bar{X}_{Medication} - \bar{X}_{Baseline}}{S_{Baseline}},$$

where *ES* refers to effect size; $\bar{X}_{Medication}$ is the mean rate of responding across all functional analyses sessions during the final medication phase for each participant dataset; $\bar{X}_{Baseline}$ is the mean response rate across all functional analyses sessions during baseline for each participant dataset; and $S_{Baseline}$ is the standard deviation across functional analyses sessions during baseline. Negative effect sizes indicated that lower levels of challenging behaviour coincided with medication addition, while positive effect sizes suggested medication was associated with higher levels of behaviour. Out of the 37 datasets reviewed, 29 showed moderate to large reductive effects (-0.3 to -0.99), while 11 showed small to negligible effect size (-0.3 to 0)

(Figure 1). Only two datasets showed relatively large effect sizes (> -0.99). We then used effect size to describe rate-dependency, which has been defined by Poling (2000) as the relation between the relative change in response rates after a medication change and baseline response rates. We found that the magnitude of medication effect was associated with the baseline level of responding (Figure 1). Namely, datasets with higher rates of baseline responding typically coincided with lower effect sizes. We also reported that medication induced larger reductive effects in undifferentiated functional analyses, functional analyses of disruptive behaviour, and functional analyses conducted in the presence of MPH.

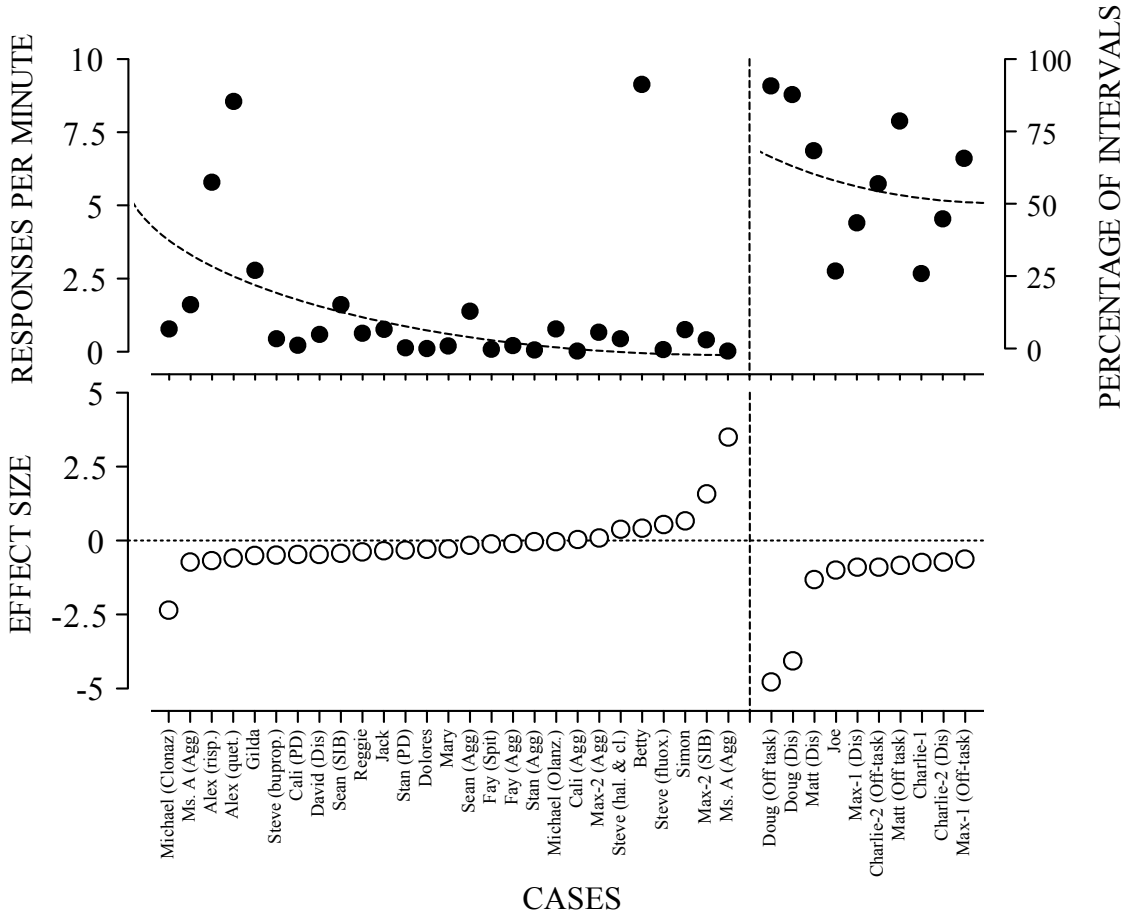

Figure 1. Rank-ordered effect sizes of medication across functional analysis conditions (open circles, bottom panel) and mean level of responding in baseline functional analysis (closed circles, top panel). Left y-axis on the top panel represents mean level of responding for cases where target behaviour was collected as response per minute. Right y-axis represents mean level of responding for cases where target behaviour was collected as percentage of interval responding. The vertical dashed line separates cases where target behaviour was collected as response per minute and percentage interval of responding. Logarithmic trend lines have been added to facilitate visual analysis (Cox & Virues-Ortega, in press).

To evaluate behaviour function correspondence associated with medication changes we compiled all datasets comprised of side-by-side functional analyses conducted in the presence and absence of a target medication manipulation. Behaviour function correspondence was defined as no change in the function of a target behaviour across baseline and final medication phases. Specifically, we calculated the overall mean and standard deviation of responding during baseline and medication functional analyses separately. Subsequently, mean response rates were converted in each condition to standard deviation units from the mean standard deviation. Out of the 37 participant datasets 73% showed function correspondence, 22% showed function subtraction, 3% showed function addition, and 3% showed a function change. Thus, Cox and Virues-Ortega concluded that function-specific effects are not prevalent across most of the literature.

1.4-2 Rationale for extending medication-behaviour interaction research.

The outcome of the review summarized above emphasizes how low the overall number of published cases is, thus definitive conclusions remain elusive (Cox & Virues-Ortega, in press). In addition, studies have included experimenter involvement in all research sessions (e.g., undergraduate and graduate students), rather than having clinicians trained and responsible for independently conducting sessions. Consequently the utility and feasibility of running regular functional analyses across medication changes to inform future treatment decisions in a clinical setting has not been empirically established. Moreover, the medications evaluated within the context of a functional analysis are limited and need to be expanded (Cox & Virues-Ortega, in press). Finally, some of the studies available manipulated medication administration and dosages in order to reveal its effect on behaviour (Crosland et al., 2003; Danov et al., 2012; Zarcone et al., 2004). This approach would be impractical in most applied settings where medication

changes result from the independent clinical judgement of the medical staff. Therefore, developing studies incorporating research designs with the capacity to evaluate medication-behaviour function relations without directly manipulating dosages would address ongoing ecological validity concerns.

1.5 Experimental Designs for the Analysis of Medication Effects in Behaviour Analytic Research

Group designs are the standard for outcome research in clinical pharmacology, and the medications assessed in the current study have previously been evaluated in this capacity. Specifically, Hollander et al. (2012) evaluated fluoxetine effects on repetitive behaviours, while Jaselskis, Cook, Fletcher, and Leventhal (1992) assessed clonidine in the treatment of children with ADHD and autism. Marcus et al. (2009) assessed aripiprazole in the treatment of irritability in children with autism. Santosh, Baird, Pityaratstian, Tavre, and Gringras (2006) evaluated the impact of stimulants on children with ADHD and autism, while Tyrer et al. (2008) compared risperidone and haloperidol in the treatment of challenging behaviour in individuals with ID. These studies evaluate individual responding indirectly by using psychometric measures of challenging behaviour that are proxy-reported (e.g., ABC and CGI). Specifically, a care provider rates challenging behaviour based on how it presents topographically before and after psychotropic interventions are implemented. Efficacy is determined by averaging treatment effects across participants and calculating whether differential effects across treatment groups are statistically significant. Although group designs are valuable in a variety of contexts, they are not well suited for ascertaining time-dependent effects due to environmental factors within a single client or among small groups of individuals (Sidman, 1960). By contrast, single-case designs permit hypothesis testing for individual participants across different treatment phases (Sidman,

1960). This feature directly facilitates the evaluation of individualized dosages and idiosyncratic responding across and within participants. In fact, researchers exploring medication impact in the context of functional analysis have begun to empirically demonstrate the utility of single-case designs in this area of study. Specifically, Anderson et al. (2002) and Danov et al. (2012) employed an AB design, while Moore et al. (2009) and Valdovinos et al. (2009) used an AB/BA design. Crosland et al. (2003) and Danov et al. (2012) used variations of reversal designs including AABBA and ABAB, respectively. Finally, Northup et al. (1999) used a multi-element design to explore the effects of MPH on behaviour function of challenging behaviours exhibited by children with attention-deficit hyperactivity disorder (ADHD) in the classroom. Mock data were used to create Figure 2, which is a visual representation of some single-case designs that have been used in existing human medication-behaviour research.

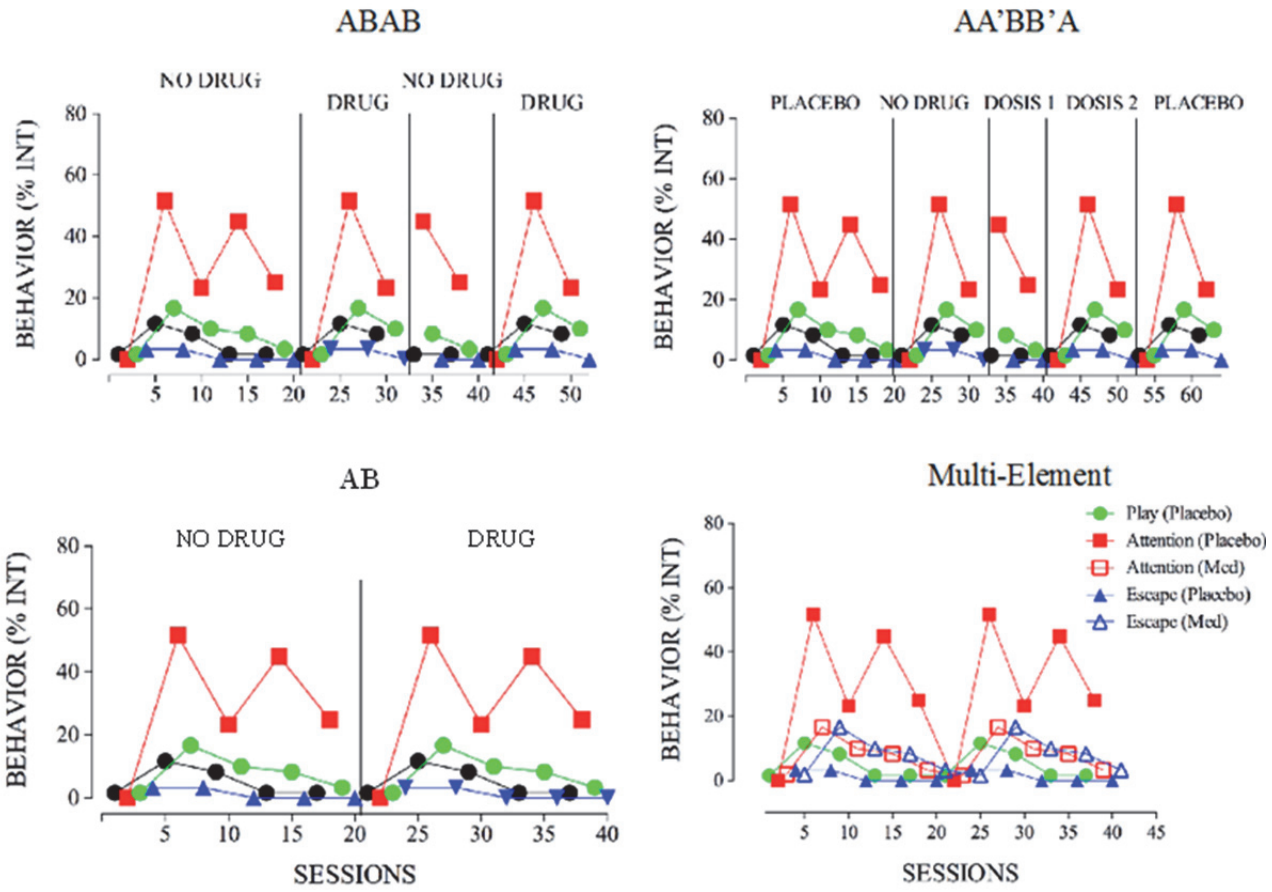

Figure 2. Mock data of research designs used in existing medication-behaviour interaction research in humans. Y-axis is percentage of interval responding of the target behaviour. X-axis is session number. Top left graph is an example of a withdrawal design. Medication phases are marked above the x-axis. Top right graph is an example of a modified withdrawal design. Medication phases are marked above the x-axis. Bottom left graph is an example of an AB design. Medication phases are marked above the x-axis. Bottom right graph is an example of a multi-element design. Medication administration is alternated across session days, and functional analyses are repeatedly conducted to assess medication-behaviour interactions. Note: A=Placebo, A'=No Drug, B=Dose 1, B'=Dose 2, A=Placebo.

Of note, few existing studies have explored medication-behaviour interaction via a parametric design (Hayes, Barlow & Nelson-Gray, 1999, p.167). Namely, researchers have not measured the relative effectiveness of several variations of a specific psychotropic medication along a continuum in the context of functional analysis.

1.5-1 Bradford-Hill criteria for causation and parametric analyses.

The Bradford-Hill criteria for causation in epidemiology are applicable to the analysis of quasi-experimental (naturally-occurring) variables in a functional analysis (Hill, 1965). Several of these criteria are highly relevant to postulate a cause-effect relation between medication changes and changes in behaviour and behaviour function. Specifically, six of the criteria can be applied to response rate: (a) medication induces effects that can be replicated (consistency), (b) medication induces effects of significant magnitude (strength), (c) medication alters responding in some but not all functional analysis conditions (specificity), (d) gradual or parametric changes in medication induce gradual changes in response rate (dose-response relation), (e) medication changes precede changes in response rate (contiguity), and (f) changes in response rate could be attributed to some of the pharmacological effects of the medication (biological plausibility). Figure 3 presents hypothetical graphs illustrating each of the abovementioned potential effects, except biological plausibility (see a review of the applications of the Bradford Hill causal criteria in medicine in Ward, 2009). Specifically, the graph in the top left corner of Figure 3 illustrates consistency. There are horizontal blue lines above the x-axis to highlight repeated medication changes. More importantly, the vertical blue lines parallel to the phase change lines emphasize a repeated, reliable change in response rate across dosage changes. Thus, suggesting the presence of *consistency* in that medication changes impact response rate consistently.

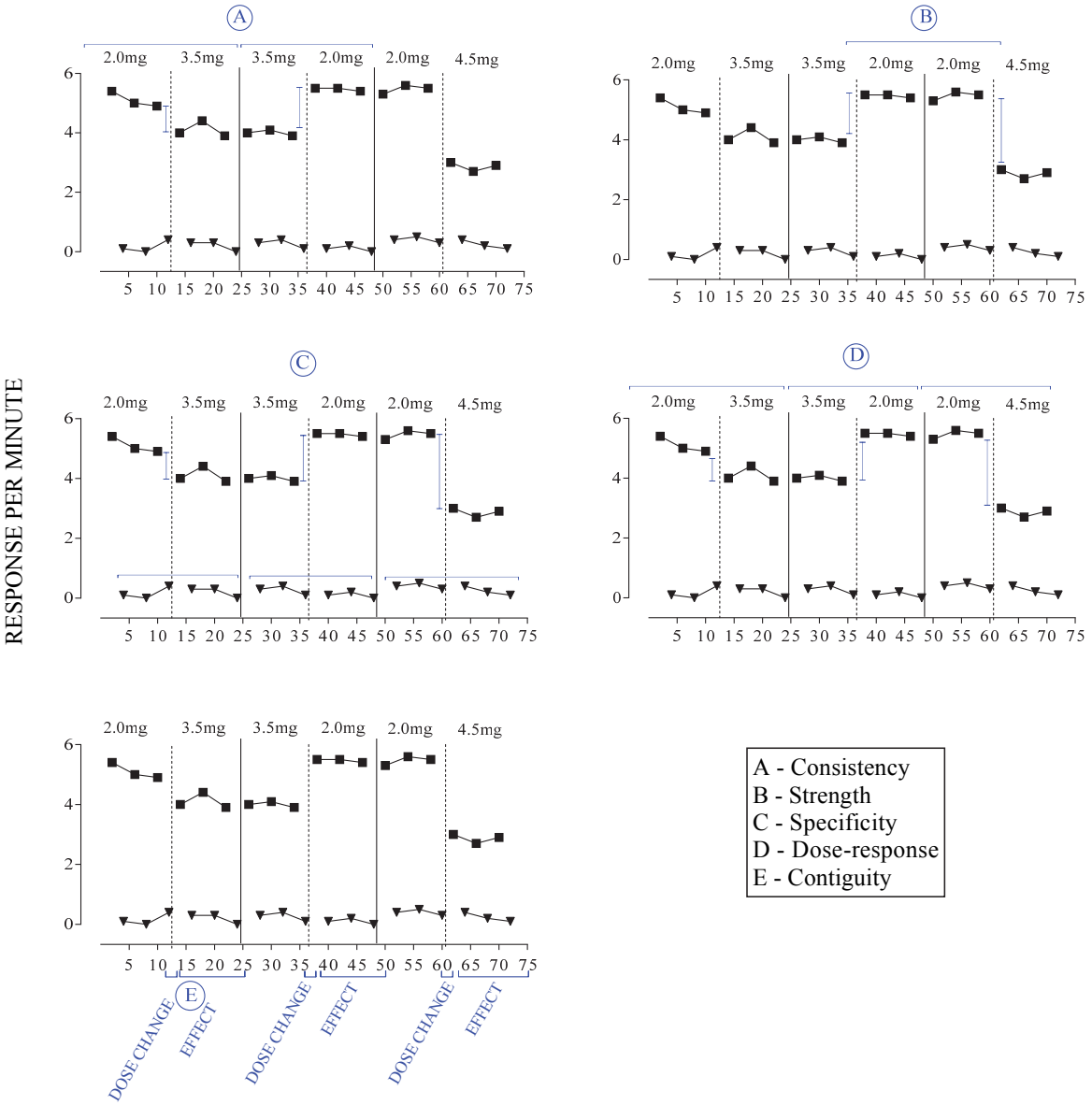

Figure 3. Hypothetical graphs illustrating consistency, strength, specificity, dose-response, and contiguity effects for response rate according to Hill (1965). Y-axis is response per minute of target behaviour. X-axis is session number. Medication dosages are marked above the x-axis. Vertical blue lines emphasize specific observed effect. Horizontal blue lines above medication dosage emphasize pertinent dosage comparisons. Horizontal blue lines in (C) emphasize no change in response rate in one condition, and change in response rate in comparison condition across medication phases. Text below y-axis for (E) emphasizes replicated observed effect.

These six criteria can also be applied separately to behaviour function: (a) medication induces effects that can be replicated (consistency), (b) medication induces effects of significant magnitude (strength), (c) medication alters some but not all behaviour functions (specificity), (d) gradual or parametric changes in medication induce gradual changes in behaviour function (dose-response relation), (e) medication changes precede changes in behaviour function (contiguity), and (f) changes in behaviour function could be attributed to some of the pharmacological effects of the medication (biological plausibility). Figure 4 shows hypothetical graphs illustrating each of the abovementioned potential effects, except biological plausibility (see a review of the applications of the Bradford Hill causal criteria in medicine in Ward, 2009). Specifically, the graph in top right corner of Figure 4 fulfills Bradford-Hill's strength criteria. The horizontal blue lines above the x-axis highlight repeated medication dosage changes. More importantly, the vertical blue lines parallel to the phase change lines emphasize the substantial change in behaviour function. Namely, prior to the dosage increase the target behaviour was maintained by social negative reinforcement (escape from demand). However, after the dosage increase the functional analysis suggests an undifferentiated function. Thus the strength of the behaviour function was substantially altered, and fulfills Bradford-Hill's strength criteria.

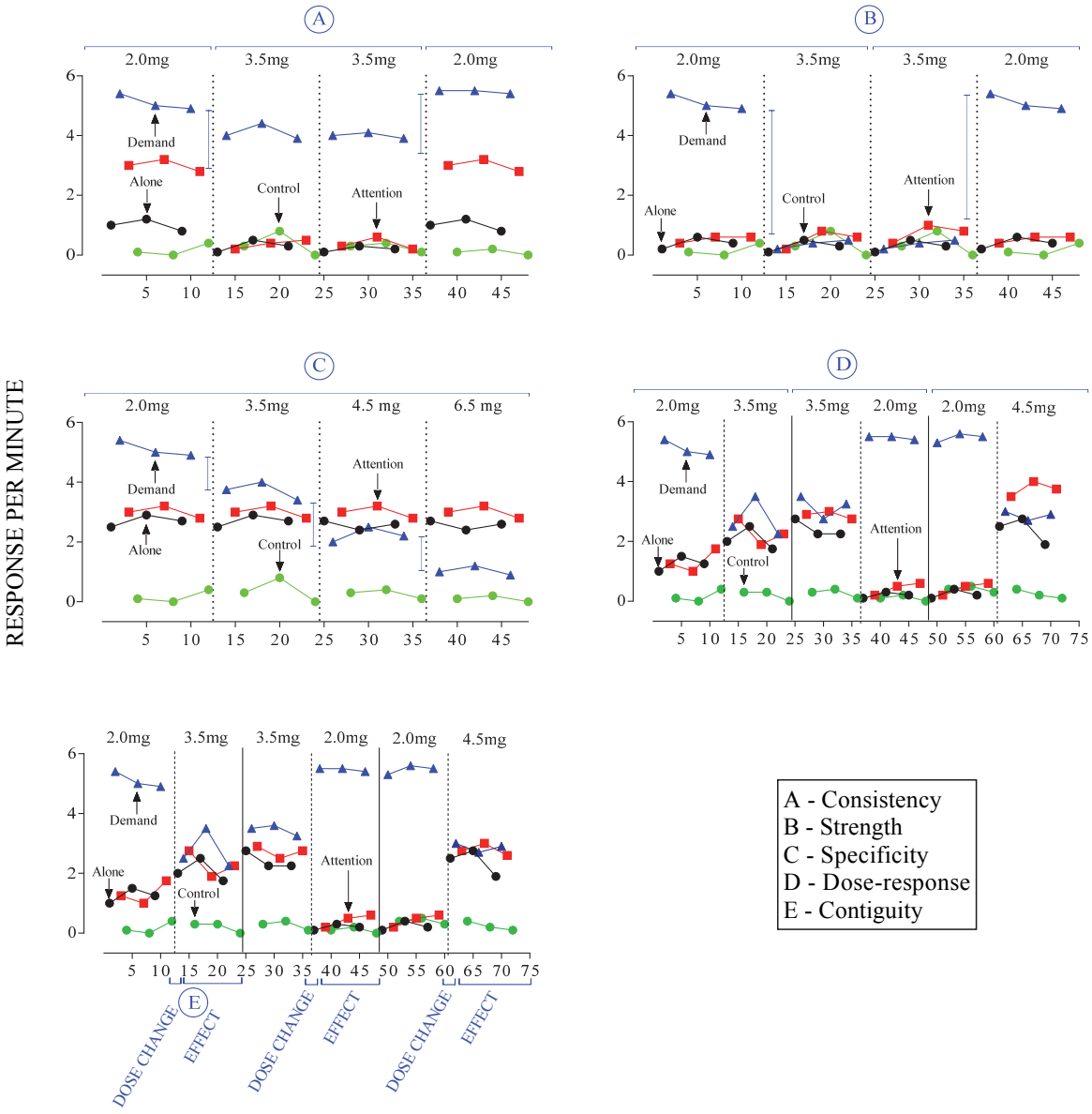

Figure 4. Consistency, strength, specificity, dose-response, and contiguity effects for behaviour function according to Hill (1965). Y-axis is response per minute of target behaviour. X-axis is session number. Medication dosages phases are above the x-axis. Blue vertical lines emphasize specific observed effect across phases for impacted test condition. Horizontal blue lines above medication dosage emphasize pertinent dosage comparisons. Text below y-axis for (E) emphasizes replicated observed effect.

Assessing whether the Bradford-Hill criteria are met may be achieved by employing a range of single-case designs including reversal, withdrawal, AB, or parametric to explore changes in medication within a series of typical functional analyses. In this context, changes in medication are conceived as a quasi-experimental variable that is independent of the actions of the experimenter (see Valdovinos et al., 2009).

The flexibility afforded by single-case designs made it possible to explore medication-function interactions in the current project. Moreover, incorporating naturally-occurring variables into the experimental design strengthened the ecological validity of functional analysis methodology beyond analyses by previous research (e.g., Crosland et al., 2003, Northup et al., 1999, Zarcone et al., 2004). While a quasi-experimental study permits only a minimal level of control, a parametric analysis is one methodological approach that may help to strengthen the causality connotation of non-purposely manipulated medication changes. Variations of parametric designs have been used frequently in the applied literature to evaluate variables such as reinforcer magnitude and schedule effects (e.g., Carr, Baley, Ecott, Lucker, & Beil, 1988; Smith, et al., 1999; Lerman & Iwata, 1996; Sy & Borrero, 2009), thus evaluating medication-behaviour interactions may be a natural extension of this research design.

1.6 Some Interactions of Pharmacodynamic and Operant Processes

Basic research in psychopharmacological effects on operant processes can provide the foundation for investigating medication-behaviour interactions in the applied realm, and allow applied researchers to make evidence-based speculations about their results. For example, basic research suggests that the neurotransmitter dopamine (DA) is directly involved in positive reinforcement, movement, and aggression (Couppis, Kennedy, & Stanwood, 2008; Schultz, Dayan & Montague, 1997; Suri, Bargas, & Arbib, 2001). Research has also found that the

nucleus accumbens, a part of the limbic system with dense dopaminergic neuron assemblages, is actively involved in reward processes. Couppis and Kennedy (2008) used this evidence to examine the differential effects of DA receptor antagonists' on aggressive behaviour and general movement in mice. The authors established a functional relation between access to aggression as a positive reinforcer, and then later suppressed aggressive responding by locally administering three different dosages of a dopaminergic antagonist (sulpride) into the nucleus accumbens. The results showed that aggressive responding was almost completely suppressed at higher dosages, compared to lower dosages which had only moderately suppressive effects. They concluded both D_1 and D_2 receptors in the ventral striatum are involved in the rewarding properties of aggression. These results are particularly interesting because atypical antipsychotic medications are often considered DA antagonists (see Table 1). More specifically, they compete with endogenous DA and bind to D_2 receptors (Seeman, 2005). As was illustrated by Couppis and Kennedy (2008), manipulating DA may influence operant responding, which could in turn differentially influence behaviour function across different dosage levels.

As a result of basic research, Crosland et al. (2003) were better able to speculate on their function-specific effects. Namely, they posited that risperidone may have impacted behaviour by lowering the aversiveness of demands, thus decreasing the value of escape. Danov et al. (2012) suggested that function-specific decreases reported in their research may have resulted from a selective weakening of escape or avoidance behaviour. Valdovinos et al. (2007) reported a function-specific decrease in tangible-maintained aggression when the atypical antipsychotic, quetiapine, was discontinued, and attributed this to an appetite decrease. Food became less rewarding on account of a decrease in appetite; as appetite is often altered by atypical antipsychotic medications (see Table 1).

A translational model of the operant effects of medications is presented by Northup et al. (1997b). Specifically, the authors examined the behavioural mechanisms involved in stimulant medications provided for children with ADHD to improve academic performance by conducting reinforcer assessments for three boys with ADHD. The items participants chose as reinforcers for task completion differed consistently across the medication versus no medication conditions. The authors posited that MPH may act as establishing operations for some common classroom stimuli. This study provided the basis for a translational model that may be adapted to examine medication-behaviour interactions across other psychotropic medications. Carlson, Pokrzywinski, Uran, and Valdovinos' (2012) work also encouraged further development of translational models and subsequent medication-behaviour research. Specifically, they made several recommendations involving the use of preference and reinforcer assessments, as well as alternative research designs.

Existing basic and some applied research suggests that medication-behaviour interactions may follow many different patterns. For example, a medication could alter the reinforcing effect of the stimuli, resulting in condition specific decreases (Crosland et al., 2003; LaRue, et al., 2008; Newton, Ling, Kalechstein, Uslaner, & Tervo, 2001). Specifically, responding to access a positive reinforcer diminishes after high doses of DA antagonist medications are administered (Couppis & Kennedy, 2008). By contrast, a medication could alter participant responding across all functional analysis conditions (Anderson, Vu, Derby, Goris, & McGlaughlin, 2002; Zarcone et al., 2004), by producing mild to severe sedative effects; a common outcome of some medications (Hayashi & Maze, 1993; Julien, 1995). Another possibility is that a medication could increase responding across all functional analyses conditions for specific challenging

behaviour (Valdovinos et al., 2007). Finally, medication changes could induce no change in response rate across functional analysis conditions (Garcia & Smith, 1999).

1.7 Objectives and Hypotheses

The purpose of the current project was two-fold. In Analysis 1, I further explored rate-dependency. I hypothesized that medication introduction or increase would be associated with moderate reductive effects, and that a rate-dependency function would be observed across participant datasets. Specifically, high baseline levels of responding would correspond with lower effect sizes (Cox & Virues-Ortega, in press). In Analysis 2, I explored two research objectives. First, I looked at the relation between psychotropic medications and variations in behaviour function, as well as overall behaviour change. Second, I endeavoured to establish whether a behavioural assessment strategy may be adopted by practitioners to assess ongoing psychiatric treatment and potentially inform future treatment decisions. For the first objective, I hypothesized that a high level of correspondence in behaviour function across medication manipulations would be observed (Anderson, et al., 2002, Cox & Virues-Ortega, in press, Zarcone et al., 2004). For the second, I expected that functional analysis could be adopted and implemented with high procedural integrity by practitioners to measure medication manipulation impact. This research study received ethical approval from the Psychology/Sociology Research Ethics Board of the University of Manitoba before it began (Appendix A).

2. General Method

2.1 Participants and Setting

I recruited 10 participants through two service providers for persons with disabilities in Manitoba, and one non local service provider for children with disabilities. Although 10 participants were recruited, six did not complete the study. Of those who did not complete the

study, five were excluded because they had not been prescribed medications for an extended period and the psychiatric team reported changes were unlikely. The sixth participant did not complete the study because she stopped responding during functional analysis conditions. It was likely her challenging behaviour was maintained by variables that were not presented in standard functional analysis conditions. Further investigating these variables to create idiosyncratic functional analysis conditions that would evoke responding went beyond scope of the current study.

Four individuals meeting the following inclusion and exclusion criteria were selected to participate: (a) diagnosis of intellectual disability (ID) according to their health record, (b) presence of challenging behaviour (e.g., self-injury, aggression, screaming, stereotypy, disruptive or bizarre behaviours), (c) exposure to psychotropic medication, (d) individual was either about to initiate or discontinue a psychotropic drug prescription, and (e) individual had no untreated medical conditions such as gastric disorders, terminal illnesses, sleep disorders, oral disorders (e.g., abscesses), eating disorders, ear, nose, or throat infections. Participants were not selected based on gender or age in part because existing medication-behaviour interaction research has not indicated age or gender-related effects. Namely, existing literature does not suggest there is a relation between medication manipulation and behaviour function.

The functional analyses were conducted in designated research rooms equipped with a table and two chairs, along with specific items required for each condition.

Participant 1 (P1) was a 55-year-old female who lived in a group home in the community with two other women since she was a teenager. She had a diagnosis of autism spectrum disorder (ASD) and moderate ID. P1 communicated verbally by using two-word statements and was ambulatory. P1's weight was taken regularly as part of an ongoing care routine. She weighed 61

kg throughout the study. She participated in research sessions every Wednesday at 09:30. No non-psychotropic medication changes occurred throughout the study. I also collected information on when psychotropic medications were first prescribed, time of drug administration, medication adherence, reason for prescription changes, and important life events. This information is provided in Tables 2 and 3.

Table 2

Participant Characteristics

	Age (yrs)	Weight (kg)	Medications	First Prescribed	Percentage Missed Administration	Time of Medication Administration
P1	55	61	Risperidone	July 2009	0%	08:00
P2	11	34	Risperidone	Sept 2006	1.7%	08:00 & 18:00
			Fluoxetine	April 2014	0%	08:00
P8	14	52	Methylphenidate	March 2010	0%	08:00,12:00 & 15:00
			Clonidine	March 2010	0%	
			Risperidone	July 2013	0%	08:00,12:00 & 20:00
						08:00 & 20:00
P10	15	56	Risperidone	2005	0%	08:00 & 20:00
			Methylphenidate (a)	2007	0%	08:00
			Methylphenidate (b)	2007	0%	15:00
			Fluoxetine	July 2013	0%	08:00
			Trazodone	2008	0%	20:00
			Aripiprazole	June 2014	0%	08:00

Table 3

Participant Characteristics II

	Medications	Reasons for Prescription	Significant Life Event During Study
P1	Risperidone	Reduction in challenging behaviour. Concerns about long term use on physical health.	None
P2	Fluoxetine	To address increasing self-injury related to transitioning from setting to setting.	One day after data was collected for session 13 to 24, P2 underwent routine dental procedure. He had one cavity filled and baby teeth extracted. Three days before I collected data for session 121 to 132, P2 switched classrooms.
P8	Methylphenidate	Reduced given hyperactivity-related behaviour were not prevalent.	None
	Clonidine	Reduced given hyperactivity-related behaviour were not prevalent.	
	Risperidone	Initially prescribed to address aggressive behaviour. Medications decreased given aggressive tendencies were not prevalent. Increased medication due indiscriminate decrease in activity across settings.	
P10	Aripiprazole	Prescribed to address self-directed behaviour, skin-picking and hair pulling. Hypothesized as compulsions.	In between session 76 and 77, P10 switched classrooms. In between session 61 and 62, P10 had her hair shaved very short. This impeded her ability to engage in hair pulling until it began to grow back.

Participant 2 (P2) was an 11-year-old male who lived in an institution for individuals with disabilities. He had cerebral palsy, cortical blindness, global developmental delay, profound ID, and was non-ambulatory. P2's weight was recorded as part of his ongoing care routine. He weighed approximately 34 kg throughout study. He had no communication behaviours and engaged in severe self-injurious behaviour including head hitting. He required the use of restraints to prevent excessive tissue damage from this repetitive behaviour. Research sessions were held on Tuesdays at 16:45. P2 underwent a routine dental procedure; however, this appointment did not coincide with his research session. Another minor change occurred between research session 145 and 146. Specifically, P2's probiotic dosage was increased to an adult dose. For extended participant information see Tables 2 and 3.

Participant 8 (P8) was a 14-year-old male who lived and attended school in an institution for children with disabilities. He was diagnosed with Mood Disorder – Not Otherwise Specified, ADHD, Generalized Anxiety Disorder, ASD, and moderate ID. P8's weight was measured as part of his ongoing care routine. He weighed 52 kg throughout the study. He was ambulatory and had limited communication skills. He engaged in echolalia and other non-functional repetitive speech. He primarily used single-word utterances or gestures to indicate desired items and activities. Two topographies were recorded including: table swiping and grabbing. Sessions were held on Thursday mornings (approximately 09:00) for table swiping, and Friday afternoons (approximately 15:00) for grabbing. No non-psychotropic medication changes occurred throughout the study. See Tables 2 and 3 for extended participant details.

Participant 10 (P10) was a 15-year-old female who lived and attended school at an institution for children with disabilities. She was diagnosed with ADHD, ASD, Anxiety Disorder – Not Otherwise Specified, and Stereotypic Movement Disorder with Self-Injury. P10's weight

was measured regularly as part of her ongoing care routine. She weighed 56 kg throughout the study. P10 communicated with a voice output device and also used gestures to indicate desired activities and items. Research sessions typically took place Wednesday and Thursday at approximately 09:00 and 15:00, respectively. P10 was not prescribed any non-psychotropic medication changes throughout the study. See Tables 2 and 3 for extended participant information.

2.2 Target Responses

For all participants a direct observation session was conducted to operationally define the target behaviour before initiating functional analysis sessions. For P1, grabbing was defined as any attempted or actual occurrence of closing her hand around an article of clothing or body part of another person and pulling forcefully on that item or body part. P1's psychiatrist had prescribed medication changes specifically to address this behaviour. The target behaviour for P2 was head hitting. Typically, P2 was in wrist restraints however, these were removed during all functional analyses. A research assistant (RA) was assigned to block all self-injury attempts to ensure participant safety throughout the assessments. Thus, I defined head hitting as attempted or actual forceful contact between an open hand and any part of the head. A head hitting attempt was described as P2 raising his hand and moving it quickly and forcefully towards his head however, the RA blocked his hand from making contact with his head. An actual occurrence was observed when the RA was unable to block because of how rapidly P2 engaged in the behaviour. Research assistants were able ensure the safety of P2 by blocking most head hitting instances. The instances of attempted versus actual head hits were not recorded separately. The psychiatric team prescribed medication changes to target a specific scenario (e.g., transitioning from one

setting to another) in which head hitting was commonly displayed. However, head hitting also occurred across settings throughout the day, hence the ongoing use of restraints.

For P8 two challenging behaviours were assessed: table swiping and grabbing. Table swiping was defined as pushing academic items off the desk. This behaviour was considered a secondary target behaviour because medication changes were not intended to address it, as indicated by the medical documents kept and revised by the psychiatrist. Grabbing was defined as contacting and pulling staff clothing or body parts with his hands or thumb and first finger. The psychiatric team at the school was led by a consulting psychiatrist. These individuals prescribed risperidone changes to address grabbing.

I assessed three separate topographies for P10 including: hand biting, skin picking, and hair pulling. Medication changes were prescribed specifically to treat two of the three target behaviours, skin picking and hair pulling. Skin picking was defined as pinching by forcefully closing one finger against the thumb and pulling out. She typically targeted her neck and occasionally her chin and cheek. Hair pulling was defined as any instance where P10 used her thumb and first finger to pull at the hair on her head. Hand biting was considered a secondary challenging behaviour, in that it was present but medication changes were not applied to treat this behaviour. It was defined as any instance where P10 placed her hand in her mouth and closed her teeth forcefully around her finger, thumb or the side of her hand. The biting may leave an impression on the skin, or cause tissue damage.

All challenging behaviours were recorded as responses per minute, except for skin picking. This behaviour was recorded as the percentage of intervals using partial interval recording. Skin picking occurred very rapidly making it difficult to discern the beginning and

end of each response. The dependent variable was recorded with behaviour observation software installed in a handheld computer (ABC data pro, CBTA online, Binghampton, New York).

2.3 Training

Volunteer RAs and the primary investigator conducted sessions for local participants, while behaviour specialists employed by the non-local school setting conducted participant sessions. Behaviour specialists did not begin running sessions until they had completed functional analysis training provided by the primary investigator, which was based on behaviour skills training (Reid, Parsons & Green, 2012). It consisted of a 90-minute didactic component, followed by a 30-min role play and rehearsal component. Finally, the primary investigator conducted at least one complete functional analysis alongside each behaviour specialist providing immediate in-vivo feedback. Throughout the study, research sessions were video recorded and encrypted copies were sent electronically. The primary investigator provided corrective feedback as required. Two in-person training sessions took place. Four board certified behaviour analysts (BCBA) and one school psychologist were trained in December 2013. Five behaviour technicians were trained in July 2014. The behaviour technicians were supervised by BCBAs employed by the agency that had participated in the December training session. The technicians also had an undergraduate degree in psychology, and at least six months of experience working with individuals with ID.

Research assistants and behaviour specialists were trained in Non-Violent Crisis Intervention and Professional Crisis Management, respectively. The primary investigator trained local RAs on data collection methods by having them observe several pre-recorded functional analysis videos while recording experimenter and participant behaviour. Training continued until RAs reached 95% accuracy measured by interobserver agreement with the primary investigator.

Research assistants were familiarized with the operational definitions for each participant. For local participants, at least one RA collected data while another conducted the session. For all local cases the RAs conducting research sessions were naïve to medication condition. For non-local sessions behaviour specialists were aware of medication changes. Given that participants were on their caseloads, remaining naïve to medication status would have impeded ongoing clinical support. However, RAs scoring video recorded sessions remained blind to medication status.

2.4 Interobserver Agreement

Interobserver agreement (IOA) for local participants was assessed by having a second observer simultaneously, but independently record data during at least 33% of all research sessions. For non-local participants, the primary investigator scored all of the videos independently while another local RA scored 33% of them. Interobserver agreement was calculated by dividing session time into consecutive 10-s intervals, dividing the smaller number by the larger number of responses observed during each interval and averaging those values across the session. Interobserver agreement for skin picking was calculated by number of agreement intervals. Namely, I divided the number of agreements plus disagreements multiplied by 100. An agreement interval was defined as both observers marking either the presence or absence of skin picking for that interval.

Interobserver agreement for P1 was 95% (range, 91%-100%). Interobserver agreement for P2 was 91% (range 85%-100%); while IOA for P8 – table swiping was 97% (range 85%-100%). Interobserver agreement for P8 – grabbing was 94% (range, 88%-100%). Interobserver agreement for P10 - hair pulling was 96% (range, 85%-100%); while P10 - skin picking was

98% (range 90%-100%). Finally, IOA for P10 - hand biting was 100%, (range, 100 %-100%). Overall IOA was 96% (range, 85%-100%).

2.5 Procedural Integrity

I collected time of medication administration and medication adherence information for each participant (see Table 2). P1's risperidone was administered daily at 08:00, and her staff and relatives independently reported that she accepted her medications without issue throughout the study.

P2's psychotropic medications included risperidone and fluoxetine. During this study, risperidone was an ongoing background medication. Doses of 1.5 mg were administered two times per day at 08:00 and 18:00. When fluoxetine was prescribed, it was administered once per day at 08:00 (Table 2). Over the nine months that P2 participated he missed nine risperidone dosages (1.7%) (Table 2). These missed dosages did not correspond with his research session days. None of his fluoxetine dosages were missed.

At the beginning of the study P8 was being prescribed clonidine 0.2 mg, risperidone 1 mg, and methylphenidate (MPH) 15 mg (Table 2). Medication administrations for clonidine were 08:00, 12:00, and 20:00. Methylphenidate was administered at 08:00, 12:00, and 15:00, and risperidone was administered at 08:00 and 20:00. No dosages were missed throughout the study.

At the beginning of the study P10 was taking MPH 54 mg at 08:00, MPH 10 mg at 15:00, risperidone 3 mg at 08:00 (1 mg) and 20:00 (2 mg), and fluoxetine 40 mg at 08:00. Aripiprazole dosages were given at 08:00. No dosages were missed throughout the study's duration (Table 2).

Two observers independently recorded the frequency of correct experimenter responding to participant target and non-target behaviours during each functional analysis condition for 30% of the sessions. Procedural integrity was described as: (a) having the correct establishing

operation (i.e., the presentation of demand during demand, the removal of attention during attention, and the availability of attention without the presentation of demands during control); (b) delivering the correct reinforcer following each occurrence of the target behaviour during test conditions, and the absence of contingent delivery of attention and escape during the test condition for automatic reinforcement and during control sessions; and (c) withholding any programmed consequences for pro-social or non-target challenging behaviour during all conditions. If any of these conditions were not met, an integrity error was recorded (Wacker et al., 2013).

Opportunity for experimenter responding in the ignore and attention conditions was provided by participants' engaging in either a target or non-target responses. For the control condition 10 trials were conducted. These coincided with standard 30-s non-contingent attention intervals. Additionally, participant responding provided opportunities to correctly withhold programmed consequence for pro-social, target or non-target challenging behaviour between trials. For the demand condition, task presentation marked the beginning of a trial. Experimenter responses were recorded as responses per minute. Percentage procedural integrity was calculated by the number of correct experimenter responses divided by the total number of experimenter responses, converted to a percentage.

Interobserver agreement on procedural integrity was collected on 33% of sessions. It was calculated by dividing session time into consecutive 10-s intervals, dividing the smaller number by the larger number of responses observed during each interval and averaging those values across the session. This ratio was converted to a percentage.

Mean procedural integrity for P1 was 98% (range 95%-100%). Interobserver agreement for procedural integrity was 100%. Mean procedural integrity for P2 was 100%. Interobserver

agreement for procedural integrity was 99% (range 87%-100%). Mean procedural integrity for P8 – table swiping was 99% (range 90%-100%). Interobserver agreement for procedural integrity was 98% (range, 91%-100%). Mean procedural integrity for P8 – grabbing was 98% (range, 85%-100%). Interobserver agreement for procedural integrity was 95% (91%-100%). Mean procedural integrity for hair pulling was 99% (range, 88%-100%). Interobserver agreement for procedural integrity was 97% (range, 90%-100%). Mean procedural integrity for skin picking was 99% (range, 85%-100%). Interobserver agreement for procedural integrity was 98% (91%-100%). Finally, mean procedural integrity for hand biting was 99% (range, 91%-100%). Interobserver agreement for procedural integrity was 99% (range, 91%-100%).

2.6 Design

A multi-element design was used to conduct functional analyses, as is standard practice with this assessment strategy (Iwata et al., 1982/1994a). I employed additional designs occasioned by the naturally-occurring medication changes. Specifically, I used a reversal design for P1, a withdrawal design for P2, and AB and reversal designs for P8. Finally, naturally-occurring medication changes for P10 provided an opportunity to evaluate medication effects through a parametric design (Hayes et al., 1999).

For P1, the first medication change involved reducing risperidone from 0.5 mg to 0.25 mg. This was followed by a return to the baseline risperidone level of 0.5 mg. For P2, the first medication change introduced fluoxetine 20 mg. This was followed by a return to baseline in that fluoxetine 20 mg was discontinued. For P8, the first medication change was a reduction in clonidine from 0.2 mg to 0.1 mg. The second medication change discontinued MPH. The third medication change discontinued clonidine. The fourth medication change was a reduction in risperidone from 0.5 mg to 1 mg. The final medication change reinstated the original risperidone

dosage of 1 mg. For P10, the first medication change introduced aripiprazole 2.5 mg. The second medication change increased aripiprazole to 5 mg. The final medication change further increased aripiprazole to 7.5 mg.

A total of at least three medication changes signalled the end of the experimental evaluation for a given participant, or if medication changes occurred as a reversal or withdrawal. If changes occurred more rapidly I assessed more than three medication changes (P8 – table swiping).

Functional analysis conditions served as one independent variable, while medication changes were considered a secondary quasi-experimental independent variable. The primary dependent variable was the level of challenging behaviour. This was measured through direct observation across all functional analysis conditions.

2.7 Assessment

2.7-1 Functional analysis (Iwata et al., 1982/1994a).

Each participant was exposed to at least three baseline functional analyses based on procedures described by Iwata et al. (1982/1994a). The conditions included in the functional analysis were ignore, attention, control (play), and demand (see Introduction for condition-specific descriptions). Each functional analysis condition was five minutes long with a two-minute inter-condition break. Five minute inter-session breaks were also provided. Motivating operations were maximized during the assessment by conducting the functional analysis in a fixed sequence recommended by Iwata et al. (1982/1994a) (ignore, attention, control, demand).

2.8 Procedure

Researchers were not involved in prescription changes. All adjustments were made at the discretion of the participants' consulting psychiatrist or psychiatric team.

At least three functional analyses were conducted at baseline (i.e., initial dosage level, or background medication). For all participants, functional analyses were conducted at least once every two weeks. This was done to ensure that the RAs scoring research sessions were blind to the current prescriptions for all participants. For non-local participants research sessions were recorded and encrypted videos of the session were sent to the primary investigator who was responsible for scoring sessions.

Medication changes were immediately communicated to designated research personnel (RA, or primary investigator) who were not directly involved in conducting or scoring sessions. The nurse assigned to each participant provided this information. Medication administration record sheets were also obtained for three of the four participants (P2, P8, P10) to independently corroborate this information.

When the primary investigator was involved in scoring or conducting research sessions (P1, P8, P10) information regarding changes was provided when a third medication change, or a reversal or withdrawal occurred. At this point, sessions continued only if further medication changes were likely (P8 – table swiping). If further medication changes were not expected (P1, P2, P8 – grabbing, P10) sessions were terminated and the dataset was considered complete. Research assistants helping with local sessions were blind to medication status. Unfortunately, behaviour specialists conducting non-local sessions were involved in participants' ongoing clinical support, and were aware of medication changes. However, the sessions were scored by RAs who were blind to medication status.

During each research session, three functional analyses were conducted thus 12 data points were obtained per session. Changes in all ongoing non-psychiatric medications, medical events, or other major life events were also recorded for descriptive purposes (see Table 3).

Ongoing non-psychiatric medications and medical events were confirmed by retaining copies of the medication administration record sheets for three of the four participants. Information on changes in other major life events was provided by the parent, staff, or nurse assigned to the case.

All data points collected within a medication phase were used to assign behaviour function and evaluate function correspondence, or non-correspondence, across medication phases.

3. Analysis 1

Typically randomized controlled trials suggest various psychotropic medications induce reductive effects (e.g., Sharma & Shaw, 2012). However, few studies use direct observation to evaluate behaviour change. Thus, I attempted to address this research gap by analyzing the mean effect of medication on the overall occurrence of target behaviour through direct observation data collected via functional analyses. In addition, analysis 1 served to explore the presence of rate-dependency effects; that is, the relation between the effects of medication and the baseline rate of responding (Dews, 1964).

3.1 Method

I calculated overall effect sizes for each participant's dataset to examine mean reductive effects of medication manipulations on target behaviour (Parker & Hagan-Burke., 2007). This information was also used to evaluate rate-dependency relations between baseline rate and intervention effects beyond what would be expected by the collinearity between baseline rate and effect size (Dews, 1964). To estimate the overall effects of medication I computed effect size (*ES*) for each dataset using the following formula:

$$ES = \frac{\bar{X}_{Medication} - \bar{X}_{Baseline}}{S_{Baseline}},$$

$\bar{X}_{Medication}$ is the mean rate of responding across all functional analysis sessions during the medication functional analysis for each participant dataset. $\bar{X}_{Baseline}$ is the mean response rate across all functional analysis sessions during baseline for each participant dataset. Finally, $S_{Baseline}$ is the standard deviation across functional analysis sessions during baseline. Negative effect sizes indicate that medication manipulation was associated with a lower level of challenging behaviour, while positive effect sizes suggest that the medication was associated with higher levels of challenging behaviour. An absolute effect size of 1.0 indicates that the mean difference between the medication and baseline functional analyses is greater than the variability of the behaviour (standard deviation) during the baseline functional analysis. Notably, psychotropic drugs are expected to have a reductive effect on problem behaviour, effect sizes below zero are indicative of favourable treatment effects. Alternatively effect sizes above zero denote counterproductive treatment effects. The standardized mean difference (effect size) is a common statistic in the treatment outcome literature. Thus, reporting effect sizes will place my findings in the wider context of the pharmacological treatment literature.

4. Results and Discussion

Figure 5 presents the results of standardized mean differences, or effect size for each dataset represented by the open circles. This figure also shows mean percentage interval responding during baseline, which is represented by the closed circles. Of note, rate per minute data was converted into percentage of interval values for the purpose of graphing consistency. Namely, this conversion made it easier to interpret outcomes. When effect size for medication increases or introductions were calculated, one participant dataset (P8-grabbing) showed moderate to large incremental (counteractive) effects, four participant datasets showed small to negligible reductive effects (P2, P8-table swiping, P10-hand biting; P10-hair pulling), and two

showed moderate to large reductive effects (P1, P10-skin picking). P8 medication changes included discontinuing and decreasing medications, thus effect sizes were calculated comparing baseline and final medication phases. Both topographies showed negligible effects. According to effect size, it appears medication changes had either no effect or subtle suppressive effects.

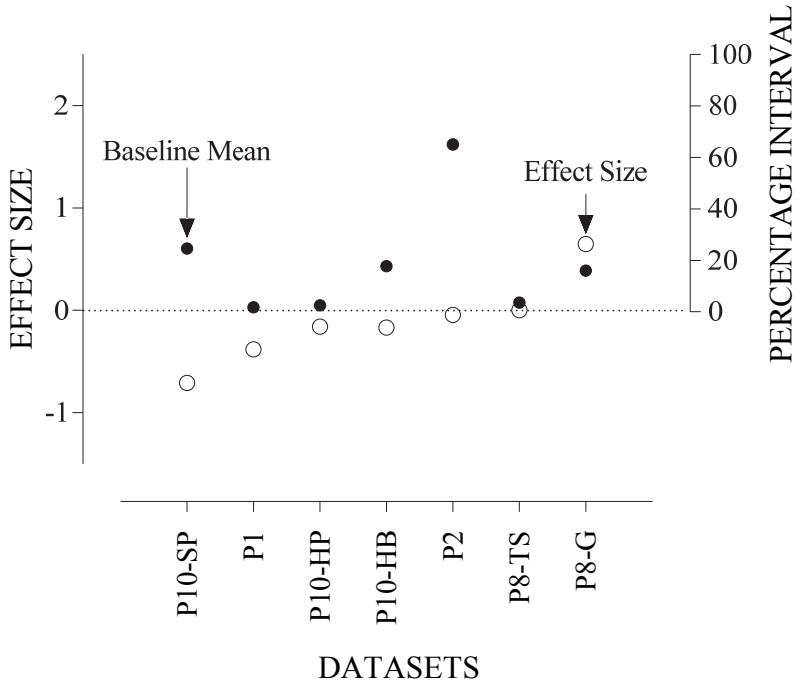

Figure 5. Rank-ordered effect sizes of medication across functional analysis conditions (open circles) and mean level of responding in the baseline functional analysis (closed circles). Left y-axis is effect size. Right y-axis is percentage interval responding. X-axis is participant datasets. Note: G-grabbing; HB-hand biting; HP-hair pulling; SP-skin picking; TS-table swiping.

Rate-dependency is a function that describes the relation between two variables, specifically the relative change in responding following drug administration (Poling, 2000). Overall a rate-dependent function was not clearly observed in this dataset. This finding contrasts Cox and Virues-Ortega (in press). Alternatively, the present results do align with previous human behaviour-medication research, which suggests the absence of bimodal rate-dependency (Cox & Virues-Ortega, in press; Teicher et al., 2003). Bimodal rate-dependency involves reductive effects for relatively high-frequency behaviour at baseline and incremental effects for relatively low-frequency behaviour at baseline (Dews, 1964). In the current study, only one dataset with low baseline levels of responding (P8 grabbing – risperidone increase) showed incremental effects after medication addition.

There may be several possible explanations for the absence of a rate-dependency function. First, medication effects may be underestimated. Namely, I used mean responding across functional analysis conditions to calculate effect sizes. Therefore, it is unlikely that datasets where challenging behaviour was condition-specific would be associated with high levels of behaviour in all conditions except for the one controlling the behaviour. Another possible explanation has to do with low baseline responding across participant datasets (Figure 5). Consequently, large reductive effects were not possible. Finally, participants might have been too few to make rate-dependency visually evident over and above the relatively high variability across participants.

In the current context rate-dependency is simply a mathematical function that describes the relation between baseline response rate and the suppressive effects of the drug. Although it is possible that rate-dependency may be obtained as a statistical artefact (see Appendix B), this is

less likely for self-correlated data (see Appendix B), which is likely to be observed when correlating pre- and post-test measures within a group of individuals.

Of note, Analysis 1 results must be interpreted with caution because of the low baseline rates, which can produce highly unstable effect sizes. In addition, there were substantially fewer cases in the current project, compared to Cox and Virues-Ortega (in press) thus baseline ranges were not as varied.

5. Analysis 2

There is an ongoing debate as to whether psychotropic medications induce function-specific effects, rather than simply producing a general decrease in challenging behaviour (Crosland et al., 2003; Cox & Virues-Ortega, in press; Dicesare et al., 2005; Valdovinos et al., 2007). Currently, evidence is scarce but support for both sides of this debate does exist. Further applied research would add to the evidence base of this understudied topic. Analysis 2 had two objectives. First, I explored the relation between psychotropic medications and variations in behaviour function. Second, I attempted to examine whether a behavioural assessment strategy may be adopted by practitioners to assess ongoing psychiatric treatment and potentially inform future treatment decisions.

5.1 Analysis

5.1-2 Graphing conventions and data analysis.

Conventional graphing strategies can obscure subtle changes in responding for extended time series data showing moderate to high variability (Repp, 1993). For these cases, data smoothing techniques may be a useful addition to a multi-element graph. In fact, data smoothing using moving averages has been recommended as a means to monitor treatment effects in highly

variable single subject studies (Kress, 1985; Sideridis, 1997). However, it should always be presented alongside the original data displayed in conventional graph (Armstrong, 1949).

A moving average denotes the general level of the original series (Armstrong, 1949). It is computed by averaging an existing observation with the preceding observations of the same condition within the data series of an experimental condition (Sideridis, 1997). Formally,

$$MA = \frac{X_t + X_{t-1} + \ldots + X_{t-n}}{n},$$

where *MA* refers to moving average, X_t is the most recent actual data point, and n is the total number of actual data points used in the calculation to produce the moving average data point. In the current study, I used a 10-point moving average. Thus, the maximum number of actual data points used to calculate a moving average data point was 10, the minimum was two. Lengthy data collection period and highly variable data warranted the use of moving averages for the current study, which were presented alongside conventional graphs (see Results).

Traditionally, moving averages literature suggests that sensitivity to change is reduced in cases where a larger number of observations are used to calculate a moving average data point (Repp, 1993). No specific number of observations has been recommended. However, a smaller number overall is preferred because datasets with longer medication phases means more data points per condition, thus producing less representative data. This is because substantially larger or smaller absolute values are required to alter the trend line, in order to more accurately reflect trends in the original data.

5.1-3 Function assignment.

Function was assigned for each medication phase using a modified version of Hagopian, Fisher, Thompson, and Owen-DeSchryver (1997) criteria, as described by Cox and Virues-Ortega (in press) and shown in Appendix C. The modified criteria are amenable to datasets with (a) no play condition, (b) less than 10 data points per condition, and (c) datasets with duration-based behaviour dimensions. Notably, these were the only items added to the original Hagopian et al., (1997) function assignment criteria. Hagopian et al. (1997) systematically evaluated the validity of their original criteria. Given we made only three relatively minor additions it may be unlikely these revisions unduly interfered with the validity of functions assignment across medication phases in the current study.

First, I applied these criteria to each dataset to assign function. The details of applying the modified criteria are shown in Appendix D (i.e., the values of the upper and lower criterion lines and the resulting function). A trained undergraduate RA was responsible for independently assigning function for 30% of the datasets. There was only one disagreement; IOA was 90%. Specifically, the RA identified skin picking during the aripiprazole 5 mg phase as multiply-controlled: automatic and social positive reinforcement, whereas I had identified the function as automatic. Although both conditions met differentiation criteria, I had invoked the downward trend criteria for the last third of the phase, rather than the last half as is described in the criteria. This was an acceptable extension of this guideline considering the length of the session, and the consensus was to retain the automatic function for this phase.

5.1-4 Bradford-Hill criteria assignment.

Descriptions provided by Hill (1965) were used to evaluate whether participants' data met any of the Bradford-Hill criteria for response rate and behaviour function (Figure 3 and 4).

Interobserver agreement was obtained for a random selection of 75% of the datasets. The primary investigator and one trained RA assessed datasets independently to determine which criteria, if any, were fulfilled. Interobserver agreement was 85% and 88% for response rate and behaviour function, respectively. Remaining disagreements were assessed and settled by consensus. Table 4 and Table 5 summarize met (+) or unmet (-) Bradford-Hill criteria for response rate and behaviour function, respectively, across participant datasets.

Table 4

Bradford-Hill criteria for response rate observed across participants.

Participant	Consistency	Strength	Specificity	Dose-response Relation	Contiguity	Biological Plausibility
P1-grabbing	+	+	+	-	+	+
P2- head hitting	-	-	+	-	-	+
P8-grabbing	+	+	-	-	+	+
P8-table swiping	-	+	-	-	+	+
P10- hair pulling	-	+	+	-	+	+
P10-skin picking	-	-	-	-	-	-
P10- hand biting	-	-	-	-	-	-

Note.'+' = criterion met; '-' = criteria not met or not applicable

Table 5

Bradford-Hill criteria for behaviour function observed across participants.

Participant	Consistency	Strength	Specificity	Dose-response Relation	Contiguity	Biological Plausibility
P1-grabbing	-	-	-	-	-	-
P2-head hitting	-	-	-	-	+	+
P8-grabbing	-	+	-	-	+	+
P8-table swiping	-	+	-	-	+	+
P10- hair pulling	-	-	+	-	+	+
P10-skin picking	-	-	+	-	-	+
P10- hand biting	-	-	-	-	-	-

Note.'+' = criterion met; '-' = criteria not met or not applicable

6. Results

6.1 Psychotropic Medication Characteristics

A total of five types of psychotropic medications were manipulated and their impact evaluated. These included: aripiprazole, clonidine, fluoxetine, methylphenidate (MPH), and risperidone. Aripiprazole was prescribed in three datasets, and medication changes were observed across all three datasets (P10 – hand biting; P10 – skin picking; P10 – hair pulling). Clonidine was prescribed in two datasets, and clonidine dosage changes were observed in both datasets (P8 – grabbing; P8 – table swiping). Fluoxetine was prescribed in two datasets, and fluoxetine dosage changes were prescribed in one of the two datasets (P2). Risperidone was prescribed for all participants, and risperidone dosages were altered in all three datasets (P1; P8 – grabbing; P8 – table swiping). Finally, MPH was prescribed in five dataset, and medication changes were prescribed in one dataset (P8 – table swiping). Three of the four participants (P2, P8, P10) had background medications ongoing while one medication at a time was systematically manipulated. For P8 medications were discontinued, therefore risperidone manipulations did not occur in the presence of background medications.

Figure 6 presents the results of P1. Data were collected over a period of approximately four months.

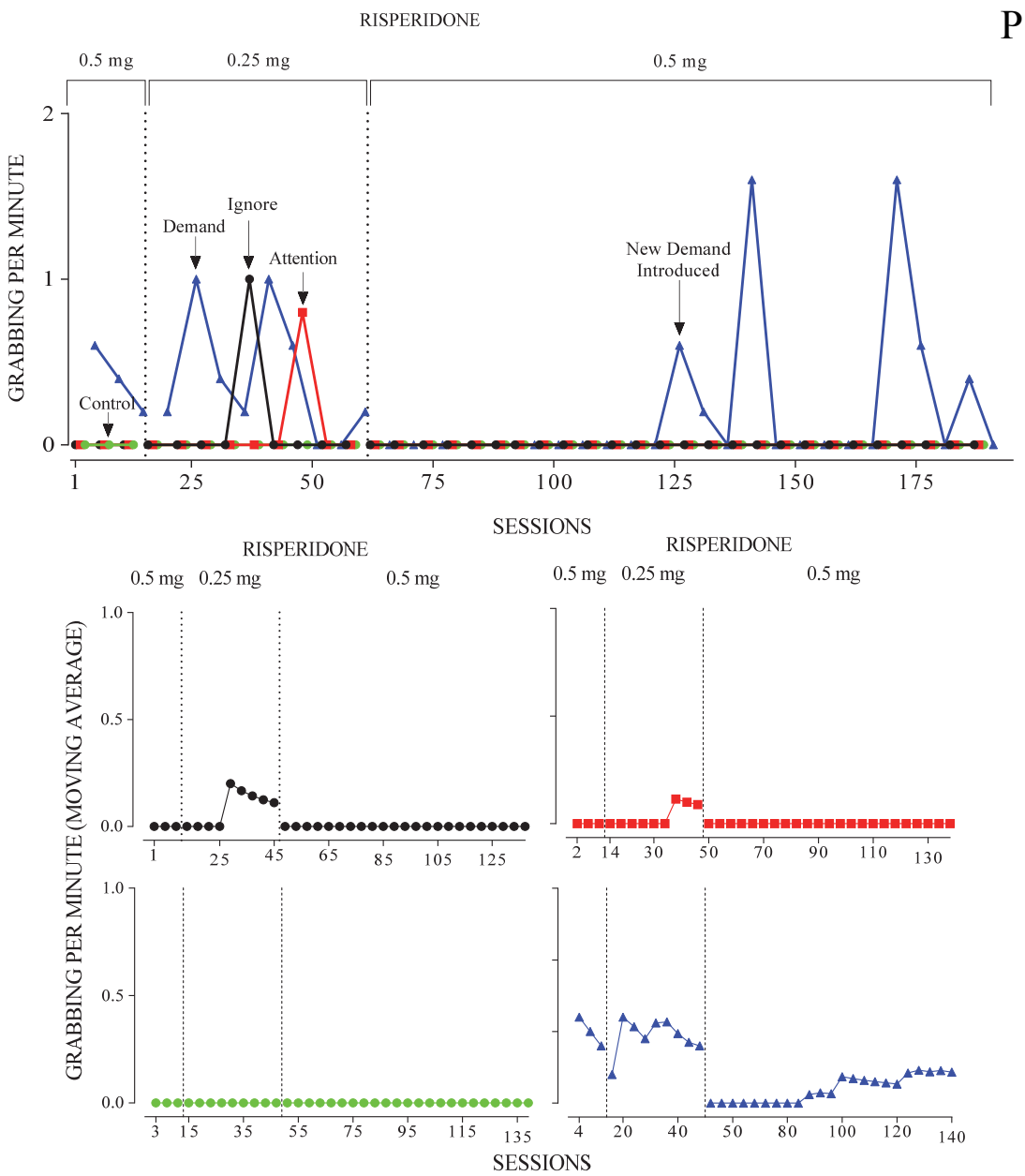

Figure 6. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. P1 response per minute of grabbing during functional analyses across all medication phases is displayed on the top panel. Functional analyses conditions are labeled within the graph, and the x-axis indicates session number. The bottom two panels display moving average response per minute for P1 grabbing during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

I observed that P1 would engage in grabbing when her adult sister conducted the demand condition, while responding remained near zero when the primary investigator conducted this condition. Therefore, P1's sister received training and delivered the demand condition during this study. During the initial risperidone 0.5 mg phase, P1 engaged in grabbing maintained by social negative reinforcement. When risperidone was reduced to 0.25 mg behaviour function did not change. However, function clarity diminished due to sporadic peaks of responding in the ignore and attention conditions. Increasing risperidone back to the original dosage of 0.5 mg produced an immediate reduction in response rate to zero across all functional analysis conditions (Figure 6). These rates persisted for the first half of this medication condition. During the second half I introduced a new task, teeth brushing, which was used across all remaining demand conditions. This additional manipulation appeared to have coincided with response re-emergence in the demand condition. Function correspondence was observed across all medication phases (see Table 4), and there was substantial overlap in response rates across the original risperidone 0.5 mg phase and the 0.25 mg risperidone phase.

Overall, decreasing risperidone did not appear to result in a difference in response rates during the demand condition but it may have been associated with responding in ignore and attention conditions. Returning to the baseline risperidone level was initially associated with a general decrease across all functional analysis conditions but responding during demand eventually re-emerged. For response rate, all of Bradford-Hill's criteria may have been met, except the dose-response criterion (Table 4). Consistency seemed to be present in that risperidone 0.5 mg phases were associated with zero rates of responding across all conditions except demand, while the risperidone 0.25 mg phase appeared to be associated with responding in ignore, attention and demand. This response pattern also seems to fulfill specificity, in that

altered response rates were observed in some (ignore and attention) but not all conditions (demand). Of note, responding in ignore and attention conditions were limited to just one session each, thus I have cautiously assigned the Bradford-Hill specificity and consistency criteria. The strength criterion appears to have been met given that increasing risperidone to 0.5 mg may have been associated with zero rates of responding across ignore, attention, and demand conditions initially. These response rates also followed medication change thus seem to fulfill contiguity (Table 5). Finally, biological plausibility may have been met given pharmacological effects could be attributing to the observed changes. For behaviour function, none of the criteria were met given function correspondence was observed across all medication phases (Table 5).

Figure 7 presents the results of P2. Data collection continued for a period of approximately eight months.

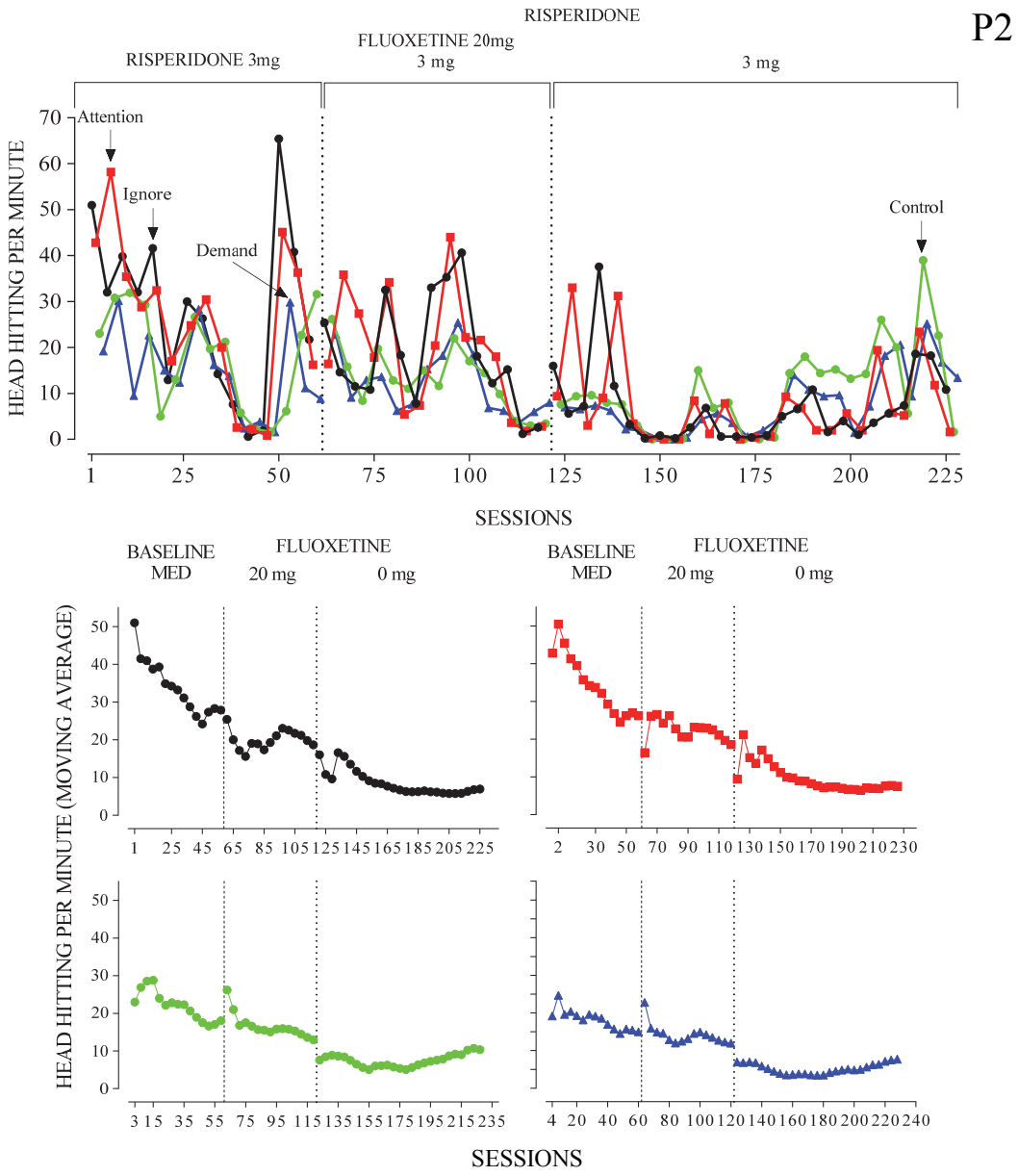

Figure 7. Participant responding is plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. P2 response per minute of head hitting during functional analyses across medication phases is displayed on the top panel. Functional analyses conditions are labeled within the graph, and the x-axis indicates session number. The bottom two panels display moving average response per minute for P2 head hitting during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

During baseline, head hitting was maintained by automatic and social positive reinforcement. This function did not change when fluoxetine 20 mg was introduced. When fluoxetine was discontinued the functional analyses indicated an undifferentiated outcome. Mean responding gradually decreased across all medication phases across all functional analysis conditions (bottom panel, Figure 7). The extensive variability in responding made some data trends more difficult to discern in the conventional multi-element graphs (top panel, Figure 7). By contrast, the moving averages graphs illustrate an overall decreasing trend across medication phases in each functional analysis condition (bottom panel, Figure 7). Data paths in ignore and attention conditions may have been slightly less variable when fluoxetine 20 mg was introduced. When fluoxetine was discontinued response rates remained similar to the previous phase for the first 28 sessions, at this point response rates persisted at low rates followed by a variable increase to the end of this medication phase. Response rates in ignore and attention conditions did not return to levels observed in the original risperidone phase.

For P2, relatively similar response rates in control and demand were observed across baseline and the fluoxetine introduction phases. The moving averages graphs illustrate a moderate but distinct reduction in response rate immediately after fluoxetine was discontinued in both control and demand. This distinction was not apparent in ignore and attention conditions. However, similar to the ignore and attention conditions, response rates did not return to the levels observed during the baseline medication phase.

Overall, introducing fluoxetine may have been associated with slightly less variability in responding across functional analysis conditions. Specifically, peak responding was lower. This medication manipulation was not associated with a function change. By contrast, removing fluoxetine may have coincided with a function subtraction, while response rates did not return to

baseline levels. For response rate, Bradford-Hill's specificity and biological plausibility criteria may have been met (Table 4). More substantial decreases were observed in ignore and attention compared to control and demand, thus specificity may have been met. Admittedly higher response rates at baseline afford an opportunity to observe more substantial decreases in ignore and attention, compared to control and demand. Finally, response rates changes could have been attributed to the pharmacological effects of medication (biological plausibility). For behaviour function contiguity and biological plausibility may have been met when fluoxetine was discontinued (Table 5). Specifically, contiguity may be met given behaviour function changed following the prescription change, which could be attributable to pharmacological medication effects.

Notably, there was substantial variability across all medication phases in all functional analysis conditions, and an overall decreasing trend across medication phases. Thus, it is possible that head hitting was not largely impacted by medication changes. Therefore, conclusions drawn from this dataset should be interpreted with caution. Moreover, it appears that an effect withdrawal was absent, even though a procedural withdrawal was implemented.

Figures 8 and 9 present the results of P8's grabbing behaviour. Data collection continued for a period of approximately eight months. Of note, the frames in Figure 8 and 9 overlap, namely session 25 to 108 are presented twice in order to clearly illustrate the AB and reversal designs (i.e., CDC).

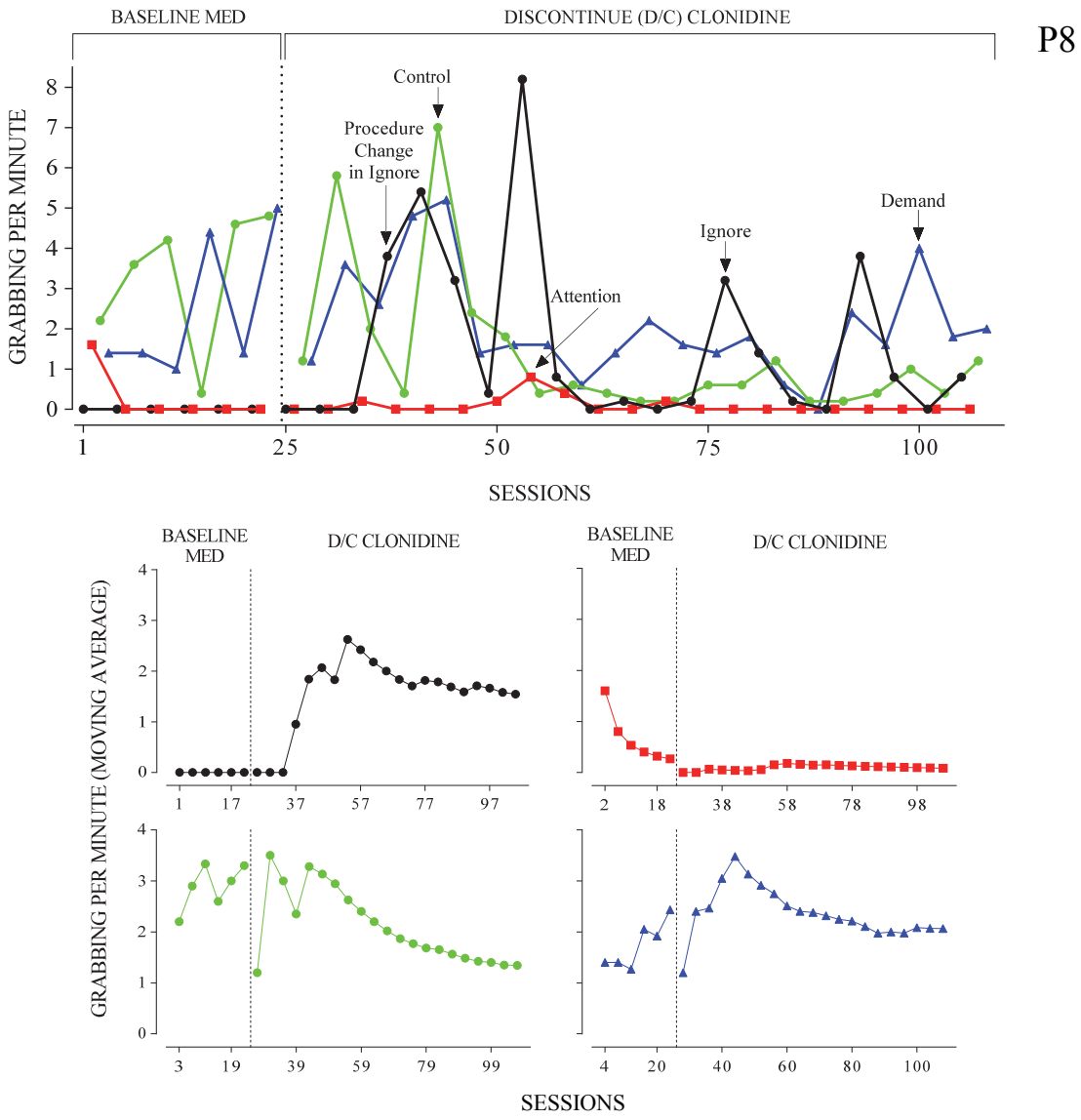

Figure 8. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. P8 response per minute of grabbing during functional analyses across baseline and clonidine withdrawal (i.e., AB) is displayed on the top panel. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P8 grabbing during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

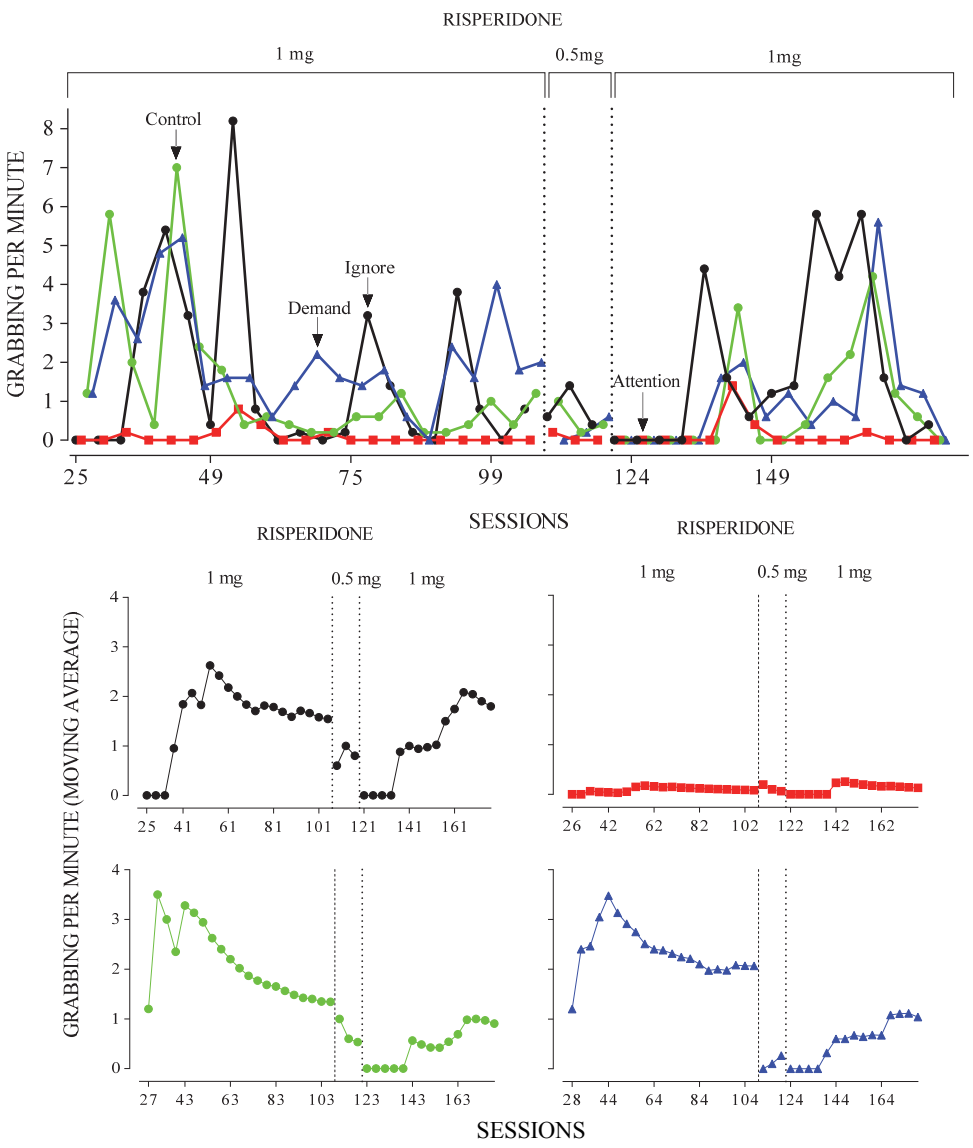

Figure 9. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. P8 response per minute of grabbing during functional analyses across risperidone reversal medication phases (i.e., BCB) is displayed on the top panel. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P8 grabbing during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

During baseline, functional analysis results were undifferentiated. Discontinuing clonidine may have been associated with a function addition. Specifically, grabbing became automatically-maintained. However, a procedural change that occurred within this phase may have impacted behaviour function. Decreasing risperidone to 0.5 mg may have been associated with a function subtraction, in that the function became undifferentiated. Behaviour function appeared to have remained undifferentiated when risperidone 1 mg was reintroduced.

Responding in the attention condition remained near zero across all medication phases. By contrast, response rates may have been differentially affected in the ignore, control, and demand conditions across medication phases. During baseline, P8 did not engage in grabbing in the ignore condition (Figure 8). After clonidine was discontinued rates remained at zero initially. However, a procedural change in the ignore condition coincided with an emergent response pattern (Figure 8). Specifically, the primary investigator advised staff conducting sessions to stand within arms-length of P8 during the ignore condition. This was done to standardize staff positioning throughout all of the functional analysis conditions. There was substantial variability in ignore during the first half of the discontinued clonidine phase, compared to the latter half where variability decreased (Figure 8). Decreasing risperidone to 0.5 mg may have been associated with a distinct reduction in response rate (Figure 9). A return to risperidone 1 mg was associated with zero levels of responding initially. However, response re-emergence occurred after several sessions. Responding continued and rates eventually reached those observed during the original 1 mg risperidone phase.

When clonidine was discontinued responding in the control condition was initially variable, and data points overlapped with those recorded during baseline. However, response variability decreased in the latter half of this medication phase, and relatively low, steady rates

persisted throughout the rest of this phase. When risperidone was decreased to 0.5 mg a distinct reduction in responding was observed (Figure 9). A return to the original risperidone dosage of 1 mg coincided with zero levels of responding initially, followed by an increase in responding. This upward trend continued throughout the rest of this medication phase.

When clonidine was discontinued responding in the demand condition persisted at moderate rates throughout this medication phase. Overall response rates did not change substantially from baseline; however, responding became slightly less varied by the end of this phase. A large, distinct decrease in responding occurred when risperidone was reduced to 0.5 mg (Figure 9). Low response rates persisted initially when risperidone was returned to the original dosage of 1 mg. However, responding re-emerged and persisted for the rest of the phase. Although, consistent responding was recorded during the latter portion of the final 1 mg risperidone phase, moving averages show response rate did not reach levels observed in the original risperidone 1 mg phase. Mean response rates largely reflect the trends and data paths described above.

Discontinuing clonidine was associated with a function addition. However, it is possible that this function addition could have resulted from the procedural change thus these results must be interpreted with caution. Of note, the second half of this medication phase revealed a slight pattern change. Specifically, response variability decreased across ignore, control and demand affording greater function clarity. If further sessions in this medication phase could have been conducted, the consistent, moderately high responding in demand suggests behaviour function may have been multiply-controlled (ignore and demand). Therefore, it could be argued that a function addition may have been observed even if the procedural change had not been implemented.

Decreasing risperidone may have been associated with a function subtraction. I observed a distinct decrease in response rate across all functional analysis conditions when risperidone was reduced.

For response rate, Bradford-Hill's consistency, strength, contiguity, and biological plausibility criteria may have been met (Table 4). Specifically, consistency may be fulfilled given that the response rates in ignore returned to similar rates of responding when reintroducing risperidone 1 mg. Responding in control and demand also re-emerged but response rates did not quite reach baseline levels. The strength criterion may be met given a distinct decrease in responding across all functional analysis conditions associated with the risperidone reduction. Contiguity may be met given the risperidone reduction preceded changes in response rates. Finally, the pharmacological effects of medication may have accounted for the observed changes in response rates. For behaviour function, Bradford-Hill's strength, contiguity, and biological plausibility may have been met (Table 5). First, the strength of the function subtraction was substantial in part because considerable decreases in response rates were observed following risperidone decrease. Contiguity may have been met since function subtraction and addition followed medication changes, although there was some delay between medication change and the behaviour function addition. Finally, the presence of function subtraction and addition may be attributed to pharmacological effects of medication (biological plausibility).

Figures 10 and 11 present the results for P8's table swiping behaviour. Data collection persisted for a period of approximately eight months

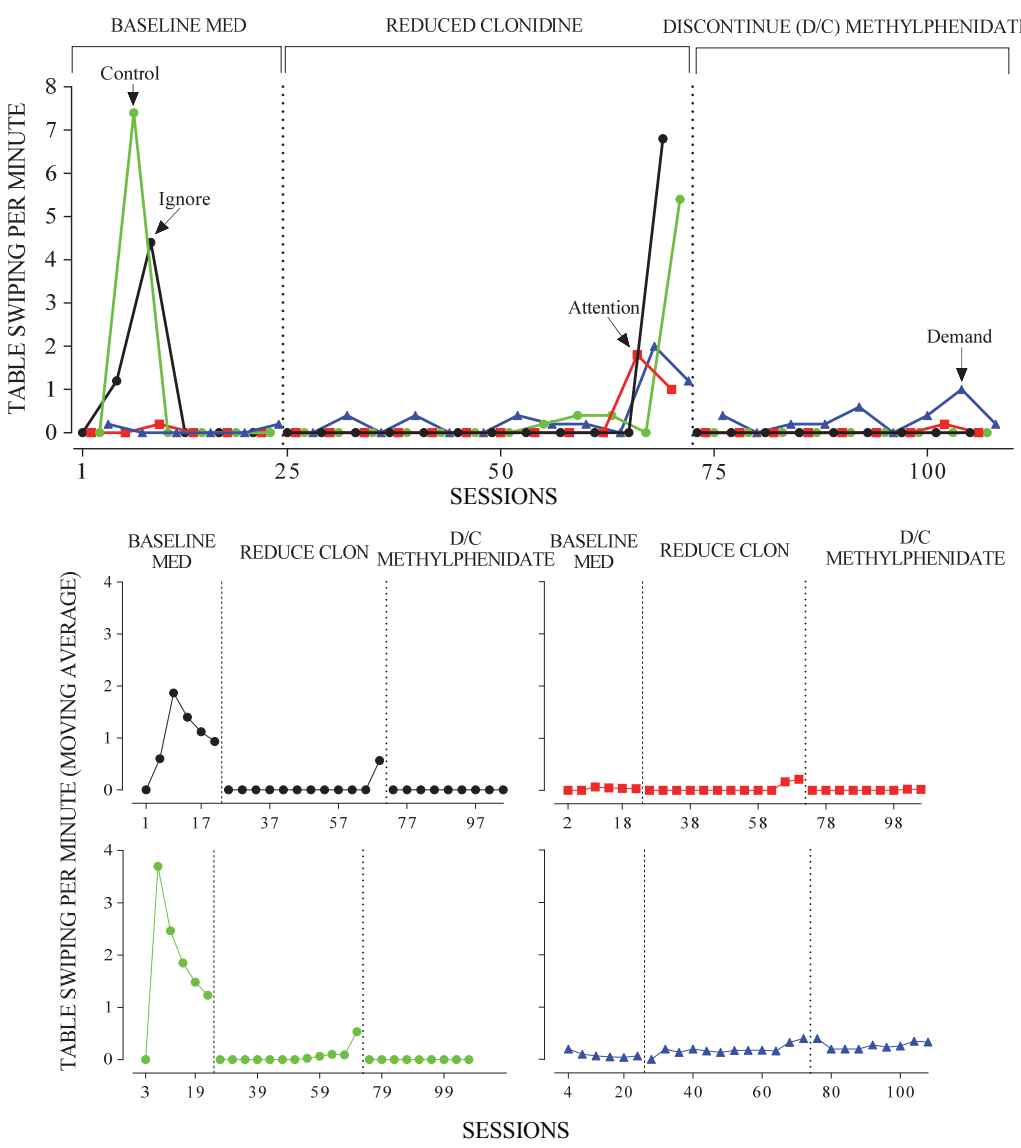

Figure 10. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. The top panel displays P8 response per minute of table swiping during functional analyses across baseline and the first two medication phases (i.e., ABC). Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P8 table swiping during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

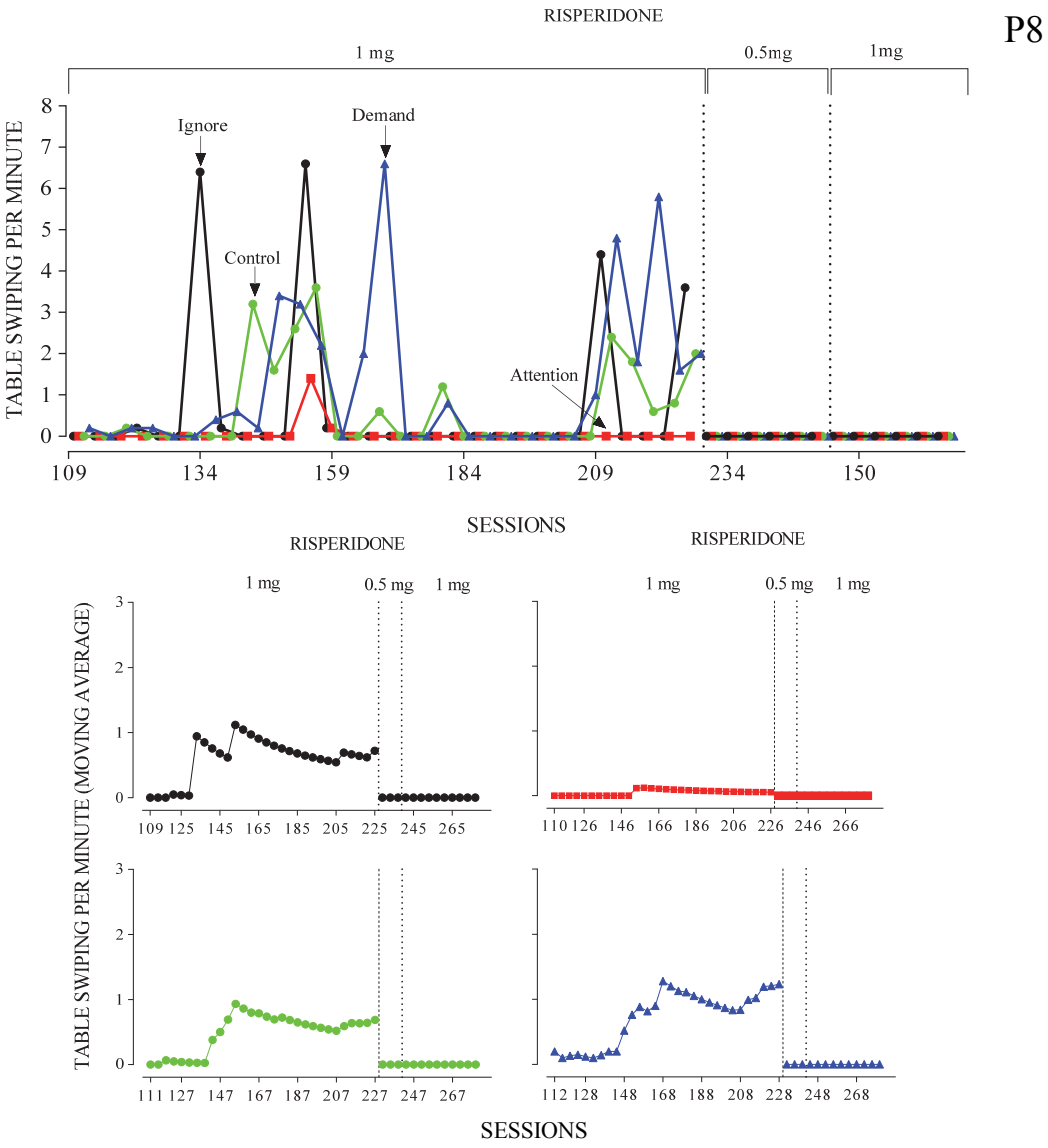

Figure 11. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. P8 response per minute of table swiping during functional analyses across risperidone reversal medication phases (i.e., DED) is displayed on the top panel. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P8 table swiping during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are shown in separate graphs.

During baseline, functional analysis results were undifferentiated. After clonidine was decreased from 0.2 mg to 0.1 mg (see Reduced Clonidine phase, Figure 10), behaviour function remained undifferentiated. A function addition may have been associated with the discontinuation of MPH. Specifically, table swiping became maintained by social negative reinforcement. Of note, response rates were quite low in demand conditions; however, given responding was near zero across all other functional analysis conditions an escape-maintained function was observed (Figure 10). When clonidine was discontinued the functional analysis indicated function correspondence. A decrease in risperidone to 0.5 mg may have been associated with zero levels of responding across all functional analysis conditions, and responding did not re-emerge when the risperidone dosage was returned to 1 mg (Figure 11). Response rates of zero persisted for the entire medication phase. Thus, behaviour function was undifferentiated in the final two medication phases (Figure 11).

Table swiping in the attention condition remained near zero across all medication conditions (Figure 10; Figure 11). In the ignore condition during baseline table swiping was present. When clonidine was reduced, near zero response rates persisted throughout this medication phase. When methylphenidate 15 mg was discontinued, a response rate of zero persisted. Response rates remained at zero immediately after clonidine was discontinued (Figure 10). However, responding eventually emerged. According to the moving averages graphs (bottom panel, Figure 11) a sharp increase in responding occurred; followed by a gradual decreasing trend during the discontinuing clonidine phase. When risperidone was reduced to 0.5 mg, response rate was zero. This trend persisted when risperidone was returned to 1 mg.

Responding occurred in the control condition during the baseline medication phase. When clonidine was reduced near zero response rates were recorded. This trend was sustained

when methylphenidate 15 mg was discontinued. A response rate of zero persisted after clonidine was discontinued however, responding eventually emerged. According to the moving average graph (bottom panel, Figure 11) response emergence was followed by an overall stable response rate throughout the rest of the medication phase. Reducing risperidone to 0.5 mg may have been associated with a response rate of zero. When risperidone was increased back to 1 mg, this trend continued.

Near zero response rates occurred in the demand condition during baseline. Reducing clonidine may have been associated with slight increases in responding. This pattern persisted until the last three sessions in this condition, where a slight increasing trend became apparent. When methylphenidate was discontinued, response patterns were similar to those observed in the previous medication phase. Relatively low, stable levels of responding persisted after clonidine was discontinued (Figure 10). However, the final five demand sessions in this medication phase show an accelerating trend. Decreasing risperidone may be associated with an immediate decrease in responding to zero, which persisted through the final medication phase.

Overall, baseline and reduced clonidine phases were associated with undifferentiated functional analysis outcomes. Discontinuing MPH may have been associated with a function addition. Namely, table swiping became maintained by social negative reinforcement. Function correspondence was observed after discontinuing clonidine, although a general increase across all functional analysis conditions was also observed. Decreasing risperidone may have been associated with a generalized decrease across all functional analysis conditions producing an undifferentiated functional analysis. Function correspondence was observed after reintroducing risperidone 1 mg.

For response rate, Bradford-Hill's contiguity, strength and biological plausibility criteria may have been met across some medication manipulations (Table 4). Specifically, a substantial reduction in response rate (strength) across all functional analysis conditions was observed immediately after risperidone was reduced (contiguity). This change could be attributed to pharmacological effects of medication. For behaviour function, contiguity, strength and biological plausibility criteria were met (Table 5). Namely, discontinuing methylphenidate and reducing risperidone may have preceded changes in behaviour function (contiguity). Reducing risperidone may have also been associated with zero rates of responding across all functional analysis conditions suggesting the strength of the function subtraction was substantial. Finally, these changes may be attributed to pharmacological effects suggesting biological plausibility.

Both table swiping and grabbing behaviours occurred at near-zero levels in the attention condition across all medication phases. A risperidone reduction to 0.5 mg may have been associated with low rates of responding in ignore, control, and demand conditions for both topographies. By contrast, increasing risperidone back to the original 1 mg dosage may have been associated with a re-emergence of responding for grabbing but not for table swiping. The latter remained at zero, while grabbing response rates gradually increased. During the final two medication phases behaviour function was undifferentiated for both topographies.

Figure 12 presents the results of P10's hair pulling. Data collection persisted for approximately eight months.

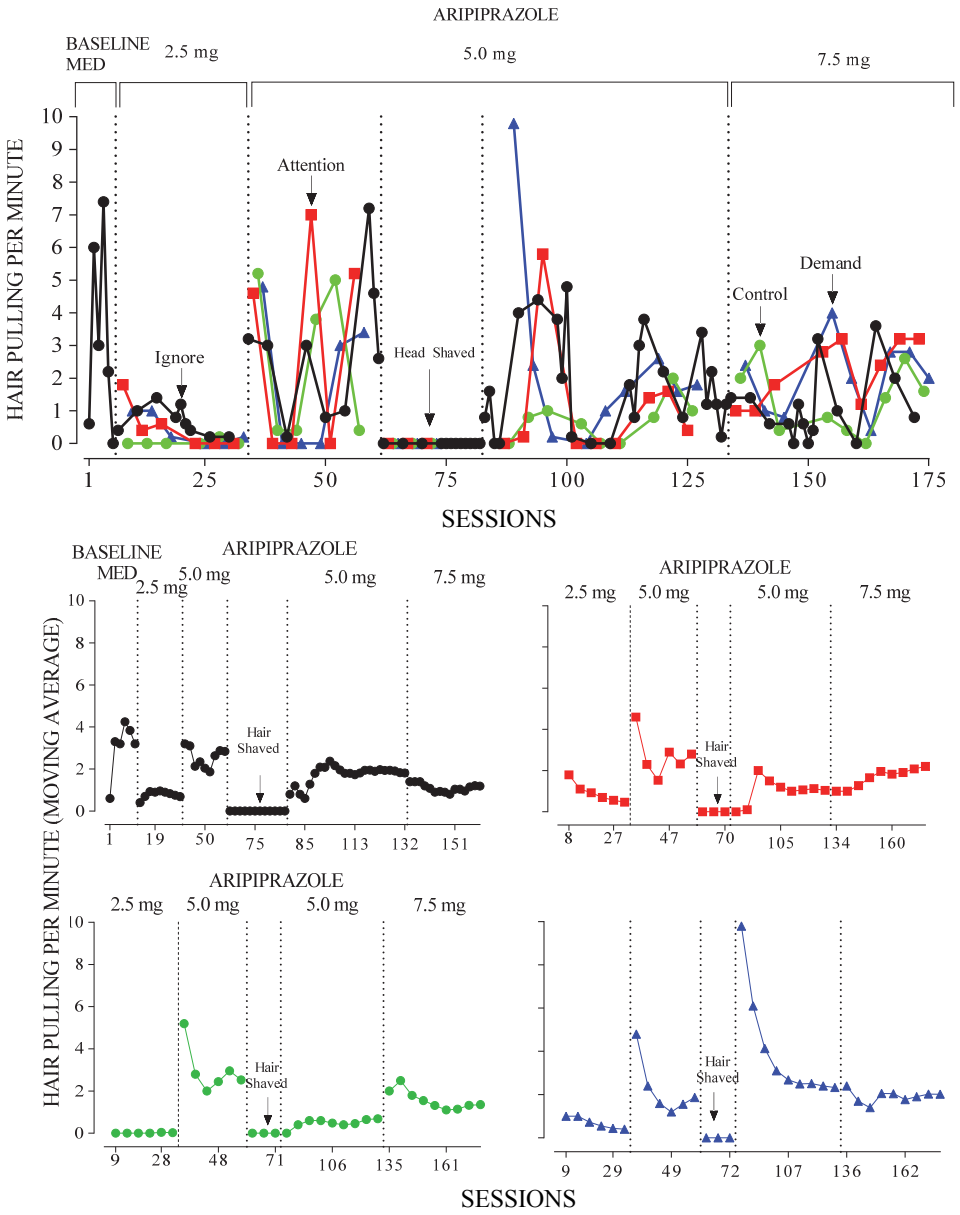

Figure 12. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. The top panel displays P10 response per minute of hair pulling during functional analyses across medication phases. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P10 hair pulling during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are graphed separately.

During baseline relatively consistent, high response rates in the ignore condition indicate the behaviour was automatically-maintained (Querim et al., 2013). Behaviour function did not change during the aripiprazole 2.5 mg, and 5 mg phases. Increasing aripiprazole to 7.5 mg may have been associated with a function change. Namely, hair pulling became maintained by social positive reinforcement. When aripiprazole was introduced (2.5 mg) response rates in the ignore conditions decreased immediately and remained low for the rest of this medication phase. Increasing aripiprazole to 5 mg may have been associated with an immediate increase in responding during the ignore condition. During the study, P10's hair was cut extremely short (hair shaved). As a result, all instances of hair pulling stopped until her hair became long enough to pull, illustrated by response re-emergence. Response rates after her hair had grown out were slightly less variable; however, responding consistently occurred throughout the latter portion of this medication phase. Responding during the aripiprazole 7.5 mg phase remained relatively unchanged from the preceding medication phase, and responding was relatively stable.

Response rates in attention, control, and demand conditions remained low during the aripiprazole 2.5 mg phase. By contrast, responding increased substantially across these three functional analysis conditions when aripiprazole was increased to 5 mg. When P10's hair was shaved response rates decreased to zero. Responding re-emerged after her hair had begun to grow out. However, the moving average data shows lower rates of responding during the attention and control conditions, compared to those observed before her hair cut (see Figure 12 bottom panel). By contrast, response rates in the demand condition showed a sharp increase after her hair had become long enough to pull, followed by a decreasing trend that stabilized at rates similar to those prior to her hair cut. Finally, increasing aripiprazole to 7.5 mg may have been associated with an increasing trend in the attention condition. Responding in the control

condition appeared to be slightly higher response rates during aripiprazole 5 mg phase, while response rates in demand remained stable across the medication phase change.

Overall, introducing aripiprazole in the presence of several baseline medications may have been associated with function correspondence, as well as a decrease in hair pulling in ignore, and low response rates in attention, control, and demand. The aripiprazole 5 mg phase appeared to be associated with an increase in hair pulling across all functional analysis conditions, as well as function correspondence. The final medication phase (aripiprazole 7.5 mg) may have been associated with a function change. Specifically, relatively similar response rates across ignore, control, and demand conditions were observed, while an increase in response rate during attention was recorded.

For response rate, Bradford-Hill's strength, contiguity, specificity and biological plausibility criteria may have been met (Table 4). Specifically, the strength criterion may have been observed when aripiprazole was introduced (2.5 mg) and increased to 5 mg. At baseline, response rates were moderate to high compared to very low responding after aripiprazole 2.5 mg had been introduced. This was followed by a substantial increase across all functional analysis conditions, which may have been associated with the increase in aripiprazole to 5 mg. Specificity may have been met given response rates increased in attention, compared to responding in ignore and demand when aripiprazole was increased from 5 mg to 7.5 mg. Contiguity may have been met given changes in response rate were observed after medication changes. Finally, these changes could have been attributed to the pharmacological effects of aripiprazole (biological plausibility). For behaviour function, Bradford-Hill's specificity, contiguity and biological plausibility may have been met (Table 5). Specificity may be observed given that increasing aripiprazole to 7.5 mg altered some but not all behaviour functions. Namely, hair pulling became

maintained by social positive reinforcement in the final medication phase. This function change followed medication manipulation, thus contiguity criterion may be fulfilled. Finally, function non-correspondence may be attributed to pharmacological medication effects.

Figure 13 presents the results for P10's skin picking. Data was collected for approximately eight months.

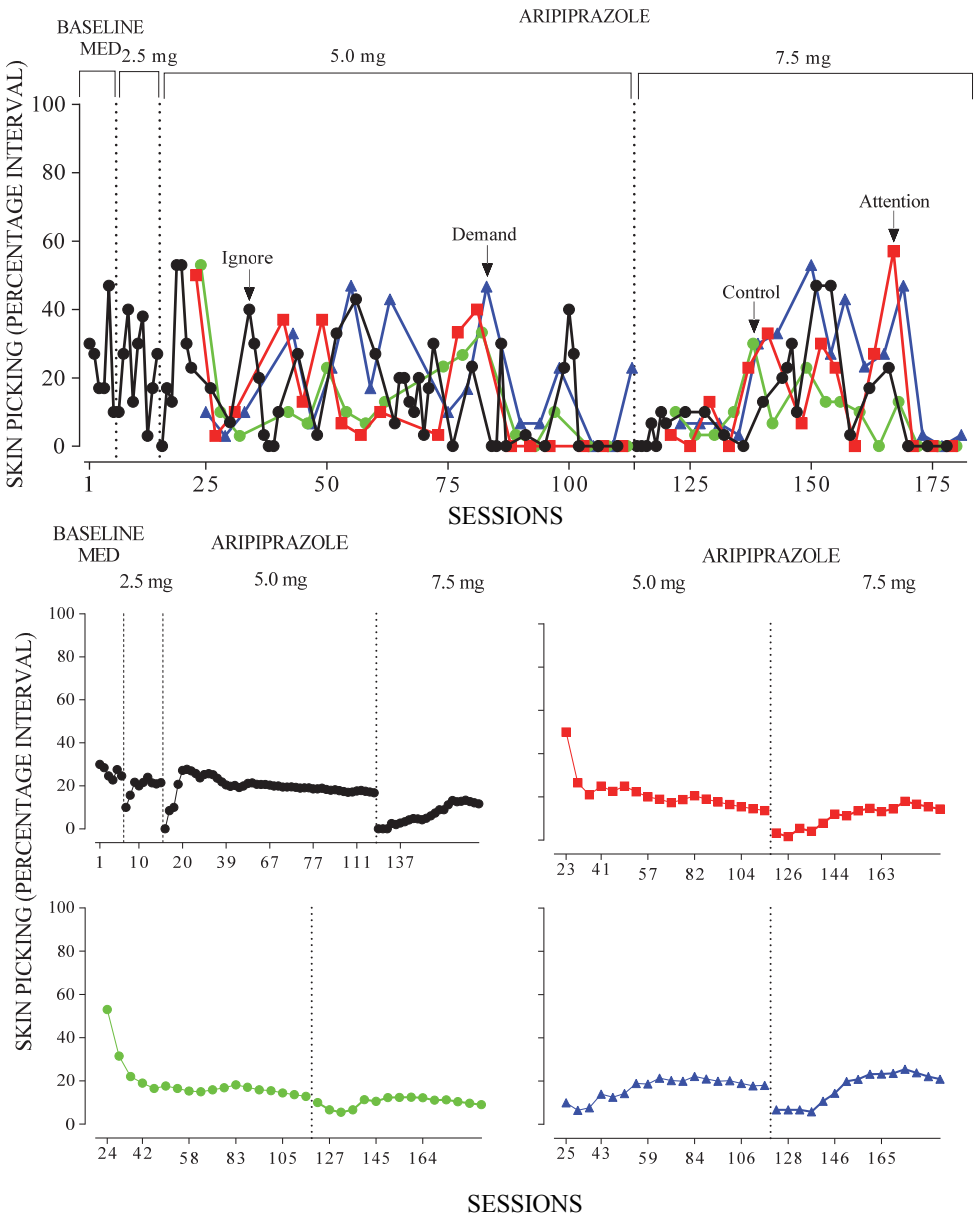

Figure 13. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. New medication phases are separated by a vertical dotted line. The top panel displays P10 percentage interval responding of skin picking during functional analyses across medication phases. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P10 skin picking during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are graphed separately.

For the first two medication phases, baseline and aripiprazole 2.5 mg, responding in the ignore condition persisted at moderate to high rates. Thus skin picking was likely maintained by automatic reinforcement (Querim et al., 2013), and function correspondence was observed across these two medication phases. Further increasing aripiprazole to 5 mg may have been associated with persistent moderate to high rates of skin picking in the ignore condition through most of this medication phase. Function correspondence may have been associated with this medication change. Finally, the aripiprazole 7.5 mg phase may have been associated with multiply-controlled skin picking. Namely, skin picking became maintained by social positive and social negative reinforcement. Response rate variability and trend in the ignore condition was consistent across all medication phases (Figure 13). During the aripiprazole 5 mg phase, response rates dropped to zero for the final three sessions. However, it is important to note that response rates of zero had periodically occurred throughout this medication phase. The aripiprazole 7.5 mg phase may have been associated with response rates that remained low initially, followed by a substantial increase in responding. During the final three sessions, response rate of zero were observed.

During the aripiprazole 5 mg phase, responding in the attention condition appeared to be substantially variable during the first half of the medication condition. Response rates then dropped to zero during the latter portion of this medication condition (see Figure 13). When aripiprazole was increased to 7.5 mg, low response rates persisted for the first third of the phase followed by responding that appears to be slightly more consistent and higher, on average, than in the preceding medication phase. However, responding dropped to zero during the final assessments conducted in this medication phase.

Response rates in demand appeared to be varied across both aripiprazole phases. When aripiprazole was increased to 7.5 mg, skin picking in demand was low initially but moderate to higher responding became apparent in the latter half of the assessment. Responding during demand was consistently higher than responding in the ignore conditions during the latter half of this medication phase.

None of the Bradford-Hill criteria for response rate were met (Table 4). For behaviour function, specificity and biological plausibility may have been met (Table 5). Specifically, function may have been altered for some, but not all functional analysis conditions. For example, responding during demand in the latter half of the aripiprazole 7.5 mg condition consistently exceeded response rates in ignore (specificity), this had not occurred in the preceding medication phase. Biological plausibility could be a contributing variable.

Figure 14 presents the results of P10's hand biting behaviour. Data collection persisted for approximately seven months.

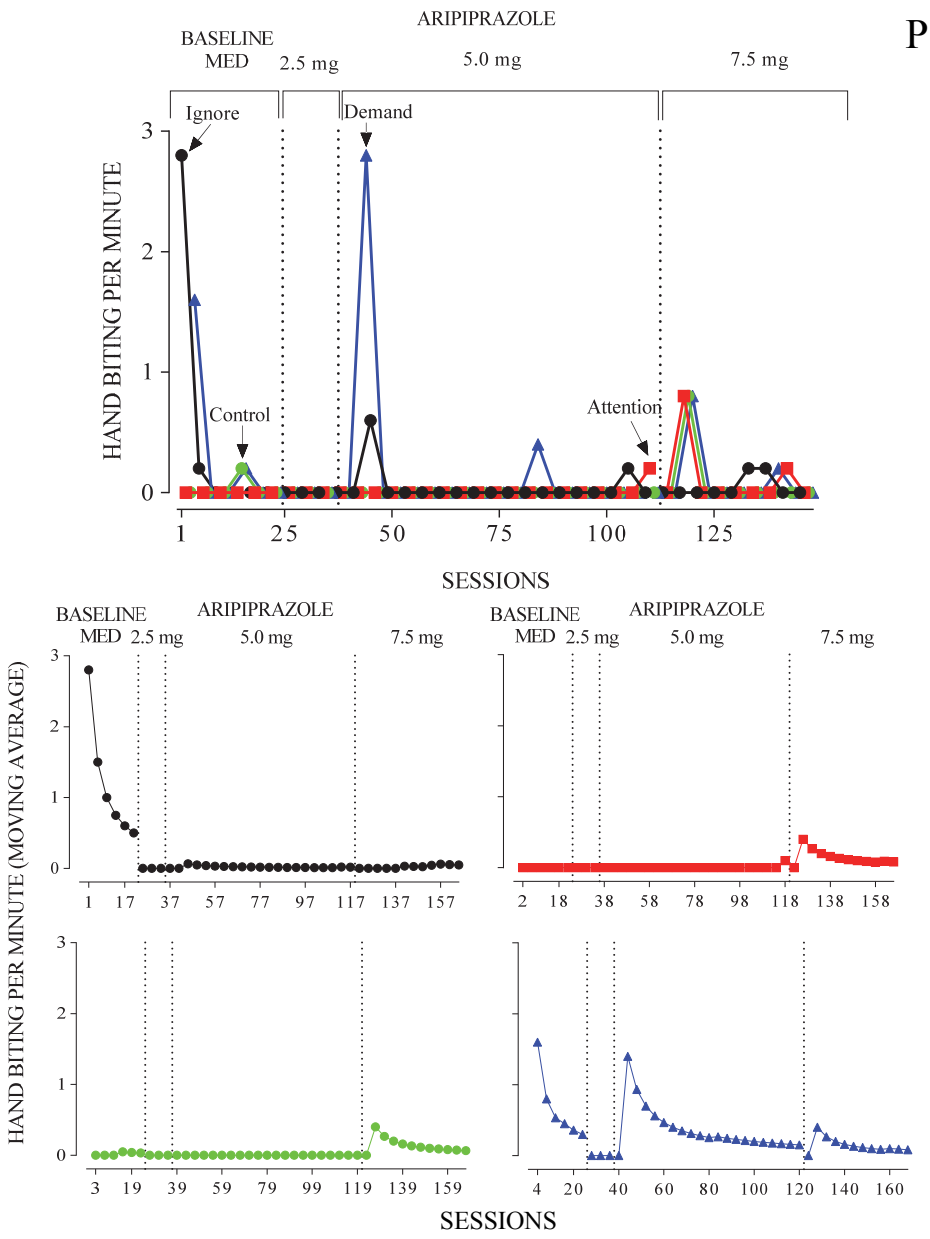

Figure 14. Participant responding plotted on line graphs. Medication phases are marked above the x-axis. A vertical dotted lines separates new medication phases. The top panel displays P10 response per minute of hand biting during functional analyses across medication phases. Functional analyses conditions are labeled within the graph. The x-axis indicates session number. The bottom two panels display moving average response per minute for P10 hand biting during functional analyses. The x-axis indicates session number. Vertical dotted lines mark the start new medication phases. Functional analyses conditions are graphed separately.

When responding occurred during baseline it happened primarily in the ignore and demand conditions. However, the functional analysis indicated an undifferentiated outcome. When aripiprazole was introduced response rates were zero across all functional analysis conditions, thus function remained undifferentiated. Behaviour function correspondence was observed when aripiprazole was increased to 5 mg. Finally, when aripiprazole was increased to 7.5 mg function remained undifferentiated.

Overall, function correspondence was observed across all medication phases. For response rate and behaviour function, none of the Bradford-Hill criteria were met (Table 4; Table 5).

Hair pulling and skin picking response rates appeared to be differentially affected by the same medication changes. Specifically, hair pulling in the ignore condition appeared to be high initially, and decreased during the aripiprazole 2.5 mg phase, followed by an increase in the 5 mg aripiprazole phase (Figure 12). By contrast, skin picking in the ignore condition remained largely unchanged across the first two medication changes (Figure 13).

Although response rates differed, potentially in response to medication changes, across topography, function correspondence and non-correspondence was similarly observed. Namely, an increase in aripiprazole may have been associated with function changes for both skin picking and hair pulling (Figure 12; Figure 13).

Medication changes did not appear to affect hand biting consistently (Figure 14). Response rates were low, although instances of hand biting continued to occur periodically across medication phases. Typically, they occurred in the ignore and demand conditions.

6.2 Function Correspondence

In total, medications were manipulated 21 times across all participants' datasets. Dosage manipulations included medication increases and decreases, and medication introduction and discontinuation (Table 4; Table 5). I observed potential function correspondence events across14 of the 21 (67%) medication manipulations. Function addition may have been observed across two medication manipulations (10%) for P8 grabbing and table swiping behaviours, while potential function subtraction events were observed across three medication manipulations (14%) in P2 and P8's grabbing and table swiping behaviour. A potential function change may have been observed across two medication manipulations (10%) in P10 hair pulling and skin picking behaviours. Five of the seven medication manipulations showing non-correspondence may have involved an undifferentiated functional analysis (P2, P8-grabbing, P8-table swiping). Finally, I can cautiously conclude that none of the function changes were replicated.

7. Discussion

There were a number of naturally-occurring medication changes that may have been associated with an array of patterns across and within the seven participant datasets. First, for P2 introducing fluoxetine may have been associated with function correspondence, while discontinuing fluoxetine appears to have been associated with an undifferentiated functional analysis. Therefore, discontinuing fluoxetine may have had some effect as an abolishing and establishing operation. An analogous result has been demonstrated with sleep deprivation as a motivating operation (MO). Namely, the presence of sleep deprivation resulted in an undifferentiated functional analysis while periods of normal sleep resulted in escape-maintained behaviour only (Kennedy & Meyer, 1996). One possible explanation for the current finding is that the process of removing the medication may have altered the value of previously reinforcing

stimuli. Thus automatic and social positive reinforcement, which competed with other forms of reinforcement in the presence of medication, no longer controls the behaviour. Another possibility is that the processes involved in introducing and discontinuing a medication may differentially impact behaviour function. These processes may act as different MOs, perhaps because distinct side effects coincide with the addition or removal of a medication (Valdovinos & Kennedy, 2004). Specifically, if introducing a medication produces side effects and discontinuing that medication produces alternative side effects, or removes side effects this could moderate medication impact by altering MOs. Moreover, the baseline medication for P1 and P2 had not been altered prior to the study for an extended period, and both had been continuously taking risperidone for at least four years (see Table 2). These factors may have contributed to the lack of replication effects observed across the procedural reversal and withdrawal. Finally, it is possible that variations in behaviour across medication phases may not be attributed to prescription changes at all. Specifically, for P2 there was substantial variability and an unstable decreasing trend across all phases, which appeared to be unrelated to medication. Thus, these data must be interpreted with caution.

Another feature to consider for P2 is whether blocking head hitting attempts differentially impacted response rates during functional analyses. Typically P2's hands were in restraints throughout the day in order to ensure his safety. However, during sessions RA's removed his restraints and blocked most self-injury attempts. Lerman and Iwata (1996) suggest that response blocking of automatically-maintained behaviour may serve as either punishment or sensory extinction. Namely, the act of blocking head hitting may be considered an aversive stimulus thereby decrease the frequency of the future behaviour. By contrast, blocking as sensory extinction would be preventing the occurrence of the positive reinforcer (sensation from head

hitting) that is maintaining the behaviour (Mazaleski, Iwata, Rodgers, Vollmer & Zarcone, 1994). In the current study, RAs were diligent in ensuring participant safety. Thus a very lean schedule of reinforcement was established, accounting for the few instances where P2 actually made contact with his head. It follows that, if blocking was acting as a punisher an immediate suppression of head hitting should have been observed and maintained; even in the presence of a lean reinforcement schedule (Lerman & Iwata, 1996). Alternatively, if blocking served as sensory extinction response rates should increase or be maintained as more responses are blocked, until extinction occurs. Given that a gradual decline, albeit unstable, in responding was observed across a nine month period, response blocking was likely not acting as a punisher or sensory extinction. Therefore, it was unlikely that response blocking was unduly interfering with response rate to the extent that it undermined my research objective.

Fluoxetine manipulations in the context of functional analysis are rare and have only targeted aggression (Valdovinos et al., 2009). Analysis 2 attempted to fill this research gap. Although I was able to provide some speculation on patterns, P2's dataset should be interpreted with caution due to the variability and periodic rebounds observed across medication phases. Given the paucity of research on fluoxetine in the context of functional analysis, combined with P2's results, more research on the impact of fluoxetine on behaviour function is needed.

Another pattern was observed when P1's risperidone dosage was reduced to 0.25 mg in that behaviour function became less differentiated. Specifically, I observed responding in ignore and attention that was not observed during baseline, which could suggest that reducing risperidone produced a general effect on response rate. However, these data must be interpreted with caution given a reversal replication was not implemented and responding in ignore and attention conditions was only observed in one session.

A return to risperidone 0.5 mg may have been associated with an indiscriminate decrease across ignore, attention, and demand conditions initially. However, response rates in the demand condition eventually re-emerged, while responding in all other conditions remained at zero. Response re-emergence coincided with a procedural change. Namely, a lesser preferred task, teeth brushing was introduced. Given that near-zero levels of responding consistently preceded this procedural change, this may suggest that teeth brushing could account for response re-emergence. Teeth-brushing was defined as placing the toothbrush in the mouth and moving it back and forth continuously across any section of teeth for at least five seconds. Another possible explanation could be that medication tolerance may be established when a stable dosage has remained unchanged for an extended period, which could differentially impact response rate (Poling, 2000, p. 59). Specifically, P1's 0.5 mg risperidone dosage had not been changed for one year. By contrast, re-introducing risperidone 0.5 mg, after reducing the dosage to 0.25 mg could have produced different pharmacodynamic effects (i.e., disrupting established tolerances), and may be reflected by the distinct response rate observed in the demand conditions (Valdovinos & Kennedy, 2004).

A third pattern was observed in both P8's table swiping and grabbing behaviours. Specifically, an indiscriminate decrease across ignore, control, and demand conditions may have been associated with a reduction in risperidone, rather than an increase as I observed in P1. Decreases in behaviour coinciding with reductions in psychotropic medications are not commonly reported (Breuning & Davidson, 1981). By contrast, some studies have reported increases in challenging behaviour coinciding with increases in medication (Fisher et al., 1989; Valdovinos et al., 2007). Notably, bidirectional medication reactions have been described as the

opposite effect than the expected beneficial effects, and are not uncommon within psychotropic medications (Smith, Hauben, & Aronson, 2012).

Another possible explanation is the influence of side effects. Overall, evaluating the behavioural processes involved in side effects has been largely neglected in applied behaviour analysis (Valdovinos & Kennedy, 2004). However, reducing risperidone may have produced side effects which competed with or diminished the effectiveness of certain stimuli as reinforcers. For example, the sensory stimuli produced by grabbing, and the social negative reinforcement produced by table swiping could have competed with other potential consequences at higher dosages. By contrast, at low dosages specific sensory stimuli and social negative reinforcement may have become neutral stimuli. Currently, speculations on the behavioural processes of side effects are conceptual (Valdovinos & Kennedy, 2004). Therefore, in addition to extending research on the primary effects of psychotropic medications, I strongly recommend conducting studies to explore the relation between medication side effects and behaviour function. Results from this work may further optimize treatment effects.

Alternative response patterns were also observed across P8's table swiping and grabbing behaviours. Namely, responding did not re-emerge when risperidone 1 mg was reintroduced for table swiping. By contrast, grabbing re-emerged, although it was in the form of undifferentiated behaviour function rather than a return to automatically-maintained behaviour. Notably, a failure to replicate has been observed in existing literature. For example, Dolores and Mary, in Zarcone et al. (2004) presented with patterns similar to P8's table swiping. Moreover, distinct responding to the same medication changes across topographies has also been reported (see Crosland et al., 2003). Another possible explanation involves behaviour function. Specifically, medication-behaviour research conducted with non-humans suggests that risperidone may differentially

affect positively and negatively reinforced behaviour (Zarevics & Setler, 1979). So, the suppressive effects of risperidone on escape-maintained table swiping may have been different, perhaps greater or longer lasting, compared to suppressive effects on automatically-maintained grabbing. At higher dosages, escape-maintained responding may be less likely to re-emerge; as observed in some previously published datasets (Crosland et al., 2003; Zarcone et al., 2004). A third possibility could be that the standard functional analysis conditions did not accurately capture function. Perhaps testing idiosyncratic functional analysis conditions would have resulted in a differentiated outcome. Thus, future research should implement idiosyncratic functional analysis conditions in situations where function is undifferentiated, specifically in cases where the undifferentiated outcome resulted from zero response rates. Researchers should also continue to explore the behavioural mechanisms involved in medication-behaviour interaction. Namely, determining whether antipsychotic medications affect avoidance responding or reduce the aversiveness of task demands in humans. Extending the literature in these ways could serve to clarify the role psychotropic medications play in behaviour function, and further investigate medications as MOs.

Finally, for P8's grabbing behaviour I observed low responding during attention paired with high response rates during control and demand. This could suggest grabbing may have been maintained by social avoidance across the baseline medication and final risperidone 1 mg phases. This could have been evaluated by implementing a social avoidance test condition, although this query went beyond the scope of the current study. However, it does suggest the need to employ idiosyncratic functional analysis conditions to thoroughly evaluate medication-behaviour interaction in the future.

Patterns across P10's hair pulling suggest greater suppressive effects at the lowest dosages compared to the highest dosage (e.g., 2.5 mg vs. 7.5 mg). By contrast, relatively similar response rates of skin picking were observed across all medication phases. However, the final aripiprazole phase appears to be associated with slightly higher response rates in attention and demand for skin picking, and slightly higher rates of hair pulling in attention. Topography may have contributed to distinct response patterns observed that appeared to be associated with medication changes (Fowler, 1992; Poling, 2000, p. 176). For example, the sensory stimulation experienced by P10 while engaging in hair pulling compared to skin picking may be differentially impacted by the same medication change, thereby producing distinct response patterns. Moreover, the different sensory stimulation experience could become more, or less pronounced at high dosages compared to low dosages. This could produce different behaviour function changes across skin picking and hair pulling, as observed in the final medication phase. Future research could evaluate this hypothesis by determining the specific sensory feedback that is sustaining automatically-maintained behaviour, while evaluating the effect of medication change in the context of functional analysis.

Aripiprazole changes also differentially affected hand biting, compared to skin picking and hair pulling. Basic researchers often assess the broad category of aggression in non-human subjects, despite the fact that aggression can take many different forms including: predatory attack, intermale attack, or infanticide (Kemble, Blanchard, & Blanchard, 1993). When aggressive behaviours are assessed individually, researchers have reported medication effects vary across behaviours (Parmigiani & Palanza, 1991). The same logic could provide an explanation for the differential outcomes observed across P10's self-injurious behaviours (e.g., skin picking, hair pulling, hand biting).

8. General Discussion

For the first analysis, I calculated effect sizes to explore potential reductive effects induced by medication. This information was also used to explore and describe rate-dependency. A bi-directional rate-dependency function was not observed across participant datasets, as I had anticipated (Cox & Virues-Ortega, in press). Notably, low baseline response rates were frequently recorded, which made observing large effects sizes unlikely. This could explain why the results of Analysis 1did not replicate those of Cox and Virues-Ortega (in press).

For Analysis 2, I used several single-case research designs to explore and report on behaviour change across psychotropic medication manipulations in an applied setting. These research designs included: parametric, reversal, withdrawal and AB designs. I hypothesized that cases of function correspondence would be prevalent. Notably, medications were manipulated 21 times across datasets and function correspondence may have been associated with 14 of the 21 medication manipulations (67%). In addition, functional analysis was successfully conducted with high procedural integrity (99%) by behaviour specialists employed by the non-local community agency partner. Thus functional analysis may be one direct assessment strategy that could be used in applied settings to evaluate medication manipulation impact.

8.1 Conceptual and Methodological Considerations

The current project presents a methodology that can be adopted in an applied setting to evaluate medication-behaviour interactions. This was made evident by the fact that clinicians (i.e., behaviour specialists) employed by a school for children with disabilities independently conducted all of the functional analyses for P8 and P10, a total of five datasets. They were able to run sessions reliably on a bi-weekly basis with high procedural integrity (99%). Functional analysis methodology affords control over reinforcement schedules across time, which can vary

extensively in the natural setting. Research has shown that alternating reinforcement schedules can produce vast differences in response rates (Davidson, Cowie & Elliffe, 2013). The random variability that exists in natural settings can mask behavioural changes coinciding with medication manipulations, thereby producing inaccurate indirect reports. Thus, functional analysis may augment existing strategies for evaluating how medication changes may impact response rate and behaviour function. However, the time required to complete sessions may become burdensome over long periods. For example, sessions typically lasted for approximately one hour and 15 minutes, and were conducted on a weekly basis for eight months for P10. Future research may begin to examine whether conducting functional analyses immediately before and after a medication change only, allowing for ample therapeutic delay, may yield accurate outcomes. This would reduce the number of sessions required to produce objective data that could be used to inform psychiatric treatment decisions. Additionally, future research might consider using variations of brief functional analysis (Northup et al., 1991). Namely, experimenters could conduct repeated functional analysis but reduce session duration, which could offer improved data collection efficiency without compromising accuracy.

The current study was able to extend the literature in several other ways. First, to my knowledge I collected more data per participant dataset than all other published studies evaluating naturally-occurring medication changes. Obtaining more data per phase is of value because it afforded more accurate function assignment. Moreover, the half-life of specific medications (e.g., fluoxetine) is lengthy, and systematic medication changes in applied settings often occur over an extended period of time, as observed in Analysis 2.

I was able to show that an extended functional analysis was feasible in an applied setting. Moreover, the outcomes of Analysis 2 may be useful in informing future treatment decisions. For

example, P2's results may have suggested medication manipulation did not significantly impact response rate. This was also the case for P10's skin picking. Thus, in the future clinicians may be more cautious of introducing these classes of medication (e.g., fluoxetine, aripiprazole) for P2 and P10, or they may elect to reinstate repeated functional analysis throughout another medication trial to augment their existing assessment strategy. Doing so may afford more efficient and definitive conclusions regarding impact and ultimately improve the timeliness of prescription decisions. In cases where medications are ineffective, a timely discontinuation decision could limit the potential for experiencing harmful side effects that are often produced by psychotropic medications (Table 1).

Second, existing literature has only evaluated low doses of aripiprazole that were directly manipulated in young children with ID to explore its effect on aggressive behaviour (Danov et al., 2012). To my knowledge, the current project was the first to evaluate higher dosages of naturally-occurring aripiprazole manipulations in an applied setting for an adolescent with ID who engaged in self-injurious behaviour. This is of value given the results from the study with children cannot be generalized to adolescents and adults due to several defining features between these populations including, but not limited to medication and learning history. In addition, aripiprazole effects on aggression compared to self-injurious behaviour likely differ. Thus my evaluation may be a welcome addition to the existing literature.

Third, few existing studies have incorporated a parametric design to examine medication-behaviour interaction. This design may have offered some experimental control, despite my quasi-experimental independent variable (medication change). Ultimately, I was able to record, explore, and report on the impact of various medication dosages across an array of topographies and functions (P10).

Finally, to my knowledge collaborating with a non-local school setting in the context of medication-behaviour interaction has never occurred. Specifically, behaviour specialists employed by the school were trained and conducted research sessions independently. Sessions were video recorded and encrypted versions were sent to the primary investigator to score. This relationship provided behaviour specialists with an opportunity to improve their own clinical skill-set (e.g., learning to conduct functional analysis), while making a direct contribution to research. Further attempts to establish this type of collaboration may improve the capacity to conduct and produce research in this extremely understudied area.

Van Haaren and Weeden (2013) made several methodological recommendations for researchers interested in pursuing pharmacological study in the context of applied behaviour analysis. They suggested following their guidelines may help to establish a methodologically rigorous study. I incorporated six of these nine guidelines. First, I obtained detailed participant medication histories (see Table 2; Table 3). Behavioural pharmacology has established that behavioural effects of pharmacological agents may vary as a function of a participant's history of medication exposure (Poling, 2000, p. 186). Gathering this information allowed me to characterize the differences in response patterns across participants. For example, I observed differences in P1 and P8 responding when risperidone was reduced. P1's responding increased across three of four functional analysis conditions, while indiscriminate decreases across three of four functional analysis conditions were observed in P8. P1 had been consistently taking risperidone for four years prior to the study, while P8 had only been taking this medication for six months. These differences could have contributed to the divergent patterns observed. Second, I obtained detailed demographic information about each participant. For three of the four participants, this information was obtained through records kept by the institutions where they

resided. Third, I was able to obtain medication administration record sheets to independently verify medication administration, and reported when dosages were missed (Table 2). Notably, missed dosages did not correspond with research session days, and occurred at very low rates. Fourth, I obtained participants' weights throughout study duration. This information was present on medication administration record sheets. Fifth, I repeatedly measured the behavioural effects of the medication within participants. Finally, I specified the time interval that elapsed between medication administration and the determination of the medication's behaviour effects. This was done by ensuring that as many research sessions as possible were conducted at the same time and day of the week. I did not incorporate double-blind experimental procedures, in part because it was not appropriate for this study's research objectives. Moreover, I was unable to secure medication administration record sheets for independent verification for P1. However, staff and P1's sister independently confirmed that her medication had been administered consistently. Notably, van Haaren and Weeden (2013) acknowledged that it may not be feasible to obtain all of the information for some participants. Moreover, their suggestions were "not to be viewed as a 'one size fits all' method for conducting research in applied behavioural pharmacology" (p. 499). Overall, I was able to adhere to several recommendations with the goal of conducting a methodologically rigorous study in an applied setting.

Another study strength is the fact that I conducted separate functional analyses for different target behaviours (Beavers et al., 2013). Some of the previous research conducted functional analyses that targeted several challenging behaviours at once (Crosland et al., 2003; Danov et al., 2012; Valdovinos et al., 2009; Zarcone et al., 2004). This may have masked behaviour function across different topographies (Beavers et al., 2013). Therefore, assessing

various topographies separately allowed me to explore medication changes within participants across topographies presenting with distinct behaviour functions.

A third study strength was the fact that medication changes included introduction and increases, as well as reductions and decreases. The effects of discontinuing a medication may be different from medication introduction (Julien, 1995; Poling, 2000; Valdovinos & Kennedy, 2004). Specifically, introducing or increasing medication may produce or amplify side effects, while reducing or discontinuing medications may decrease or remove these side effects. This may differentially impact responding, perhaps by altering MOs. Moreover, divergent response patterns (e.g., P1 vs. P8) suggest medication introduction and increases, and reductions and discontinuation may produce unexpected outcomes, thus both are equally important to assess. Therefore, not only were I justified in including participants' who were about to stop taking medication, but doing so may improve the utility of my findings for clinicians.

8.2 Potential Clinical Implications

The patterns described across and within participants may have a number of potential clinical implications. First, I can speculate that task difficulty or preference may moderate suppressive medication effects, as shown in P1. Namely, the re-emergence of responding in demand coincided with the introduction of teeth brushing. This task was hypothesized as a lesser preferred task, although it could have been task difficulty that produced responding. Unfortunately, I did not further examine this possibility because it went beyond the scope of the current study. However, this information could suggest the suppressive effects of risperidone are not exceptionally comprehensive at lower dosage manipulations. Given these effects were observed for only one case they represent one of many potential effects risperidone could have.

This information may allow clinicians to rely on risperidone to attenuate behaviour that is primarily escape-maintained, which may be particularly useful on occasions when previous attempts to reduce the challenging behaviour have failed. This result could also provide a conceptual basis for the increased effectiveness of combined interventions. Namely, it may offer a rationale for discontinuing medication after behavioural interventions have been effective. For example, after an individual has learned to perform a lesser preferred or more difficult task (e.g., teeth brushing), it may no longer be necessary to consume medications that operate by attenuating an MO that no longer induces challenging behaviour. This suggests that a combined treatment approach could hasten skill acquisition and improve overall combined treatment efficacy, which could lead to a decreased dependence on medication.

Second, in the case of the function change in P10 hair pulling, higher dosages of aripiprazole may have altered the value of sensory stimulation experienced during hair pulling. Social positive reinforcement may not have competed with sensory stimulation at low dosages, but began to compete more effectively at higher dosages. This information has practical significance in that behavioural practitioners would be prompted to revise interventions targeting automatically-maintained behaviour to accommodate the behaviour function change. By contrast, the majority of cases that showed function correspondence across medication manipulations would confirm the validity of existing behavioural interventions.

Third, I observed an overall decreasing trend across all medication phases for P2. This could suggest another environmental factor was influencing challenging behaviour. Response patterns may have encouraged the psychiatric team to consider other factors, apart from medication changes, that could have been producing the general decline in responding across the nine month period. Moreover, functional analyses data may have augmented support for the

discontinuation of fluoxetine. The functional analyses data may have prompted the psychiatric team to discontinue fluoxetine sooner, given it was not producing clinically significant decreases. Thus, the potential for side effects outweighed the benefit P2 was receiving by taking this medication. Functional analysis data for P10 may be similarly useful in that the data may suggest higher aripiprazole dosages are not associated with a substantial decrease in hair pulling or skin picking. Clinicians could use this information to consider trialing another medication to address these behaviours, given the absence of clinically significant decreases.

Fourth, the functional analyses for P8 and P10's challenging behaviours coincided with anecdotal caregiver reports on behaviour changes, which primarily inform treatment decisions. For example, a decrease in all behaviour (maladaptive and adaptive) across settings was reported by caregivers during psychiatric consultations after risperidone had been reduced to 0.5 mg for P8. These reports resulted in the reinstatement of the original levels of risperidone. The functional analysis data could have been used to corroborate indirect staff reports, and perhaps promote a heavier reliance on objective data to inform psychotropic treatment decisions in this setting. Objectively evaluating medication changes by using functional analyses could be considered due diligence, rather than solely relying on subjective reports that may vary from caregiver to caregiver. Especially in applied settings where caregivers are almost never naïve to medication changes that likely result in some bias in reporting medication effect.

Finally, differences observed across the multiple topographies assessed for P8 and P10 suggest the same medication changes may differentially impact topography. Thus, it may be inappropriate to expect global changes in challenging behaviour corresponding with medication changes. Of note, clinical pharmacological research often assesses and reports on 'aggression' or 'irritability', rather than individually evaluating the array of challenging behaviour topographies

that a participant may be engaging in (Hollander et al., 2012; Miral et al., 2008). Analysis 2 data suggests a global change in challenging behaviours (e.g., skin picking vs. hair pulling) may be absent. As a result, practitioners may consider using functional analyses to evaluate more than one target behaviour to accurately capture medication effects across target topographies, which would produce a more complete objective information package for the treatment team. Admittedly, these explanations are speculative given they are based on the outcomes of only two participants.

8.3 Limitations

There were a few limitations of the current study. First, experimental control was limited given the primary independent variable (medication change) was quasi-experimental. Specifically, researchers were not involved in the psychiatric process which determined medication changes. Although this feature reduced experimental control it also allowed me to incorporate naïve RAs, which limited the impact of experimenter bias on results.

Further, a double-blind component was not included. Namely, nonlocal research assistants (behaviour specialists) knew about medication manipulations. Despite this, experimenter bias was limited because a naïve observer (primary investigator) scored these sessions. Moreover, participants were likely informed of the medication manipulation however, their capacity to understand what these changes would mean was likely limited overall given their functioning level. Additionally, including a double-blind component may have undermined the ecological validity research objective. For example, double-blind components are not typically observed in applied settings. Therefore, incorporating this aspect into this study's methodology would have made it more difficult to explore the second research objective. Another limitation may have been the lack of a placebo component. However, as with the

double-blind component, incorporating this methodological feature may have undermined my capacity to explore ecological validity of FA in the informing future treatment decisions. Namely, placebo phases typically do not occur in applied settings. Moreover, including this component could have some ethical implications. For example, an ethics review board may consider this additional phase a delay to effective treatment in the interest of research.

Another limitation was that I could not control for non-psychotropic medication changes. Fortunately, the changes made across study duration for each participant were almost non-existent.

A fifth limitation was the fact that polypharmacy was present in P2, P10, and some medication changes for P8. Thus, there was no way to tease apart potential interactions between medication and how these interactions impacted responding. However, the reality is that many individual with ID and challenging behaviour are on several psychotropic medications simultaneously (Feldman et al., 2004; Tsiouris, et al., 2013). Study objectives indirectly addressed ongoing ecological validity concerns in medication-behaviour interaction research. Therefore, including participants who were taking more than one psychotropic medication may produce more realistic outcomes. These results are potentially more useful for practitioners, compared to studies where medication changes were made specifically to evaluate its effect on behaviour in the presence of no background medications (Crosland et al., 2003; Zarcone et al., 2004). Notably, these different research objectives (e.g., controlled vs. naturally occurring medication changes) have the capacity to produce extremely valuable outcomes. However, the goals of the current project were met by including an array of participants presenting with different psychiatric and behavioural profiles.

A sixth limitation was the procedural change in the ignore condition for P8's grabbing behaviour. Given the timing of this change, I cannot rule out the possibility that this procedural adjustment altered behaviour function during the discontinued clonidine phase. For example, if the procedural adjustment had been made prior to the first medication change I may have observed automatically-maintained grabbing. This would have produced function correspondence across the two medication phases rather than a function addition that appears to have coincided with discontinuing clonidine. Fortunately, this does not negate response patterns observed in sessions following this change. Moreover, response variability decreased across ignore, control and demand affording greater function clarity in the discontinue clonidine phase. The consistent, moderately high responding in demand suggests behaviour function may have eventually been multiply-controlled (ignore and demand). Therefore, it could be argued that a function addition may have been observed even if the procedural change had not been implemented.

Another limitation may be the introduction of the new task, teeth brushing, half way through the final risperidone 1 mg phase for P1. Research assistants conducting the session were naïve to prescription status, and the decision to implement a new task occurred after 44 sessions of zero rates of responding in the final risperidone 1 mg phase. Unfortunately I did not confirm whether responding occurred because the task was lesser preferred, or because it was more difficult as this went beyond the scope of the current study. I also did not systematically return to the original task, folding laundry, to confirm the effects of the task change. However, this additional manipulation coincided with response re-emergence after an extended period of nonresponding, an outcome that may not have been observed otherwise. Specifically, this re-emergence may suggest that I directly manipulated the MO by introducing teeth-brushing, which

could provide some evidence that risperidone may have acted as an abolishing operation (Thompson & Symons, 1999). The medication may have decreased the aversiveness of performing tasks, however, only to a certain extent. Therefore, it is possible that the impact of small prescription changes (risperidone) may not be absolute, and altering tasks may moderate impact.

A seventh limitation is that repeated exposure to functional analysis conditions may not be feasible, or desirable for some topographies. Specifically, it may be ill-advised to continually engage in functional analyses for extremely dangerous behaviour. Therefore, it is important that researchers continue to examine ways to decrease assessment duration while preserving accuracy (Northup et al., 1991; Thomason-Sassi, Iwata, Neidert & Roscoe, 2011). However, I demonstrated that implementing appropriate safety measures (i.e., blocking) can ensure participant and practitioner safety over the long term, while producing valuable objective data that may be used to inform psychiatric treatment decisions.

Finally, I cannot unequivocally rule out the possibility that datasets illustrating non-correspondence were actually attributed to 'natural' changes in behaviour function occasioned by extended functional analyses. However, there are several arguments to refute this explanation. First, not all cases of function non-correspondence occurred after an extended period of time (P8 – table swiping). Moreover, function non-correspondence was not observed across all participant datasets (P1; P10-hand biting). If function non-correspondence resulted solely from participating in an extended functional analysis, it may be reasonable to expect function changes across all datasets. Third, when function non-correspondence was observed, Bradford-Hill's contiguity criterion was frequently fulfilled (P8 – grabbing; P8 – table swiping; P10 – hair pulling; P10 – skin picking). If function non-correspondence was not associated with medication changes,

contiguity criterion may not have been fulfilled. Finally, Derby et al., (1997) conducted research examining the long term impact of functional communication training on challenging behaviour. As part of their study, they evaluated behaviour function at six and 12 months for all participants; and at 9, 12, and 17 months for one participant. Derby and colleagues assessed function by using contingency reversal conditions. Function stability was reported across all participants within the first six months. After 12 months had elapsed researchers observed function additions for two of the four participants; a function addition occurred in that behaviours became multiply-controlled. Notably, when function non-correspondence was observed it was a function addition rather than a function change. Behaviour function was stable for the first year for all participants. None of the participants in the current study were involved in research sessions for more than nine months. Thus, it is possible that when function non-correspondence was observed it was associated with medication changes, rather than as a result of extended functional analyses.

9. Conclusion

Compared to the prevalence of psychotropic medication use among persons with ID, applied medication-behaviour interaction research is scarce. The current project endeavoured to address this research gap, and made several contributions to existing literature. First, a bi-modal rate dependency function in human medication research continues to be largely absent, as observed in Analysis 1 (Cox & Virues-Ortega, in press). Second, Analysis 2 indicated medication manipulations do not often induce function-specific changes in challenging behaviour. Third, Analysis 2 demonstrated that naturally-occurring changes in medication provide the opportunity for comparisons analogous to parametric, reversal and withdrawal designs. However, medication effects rarely produced immediate, sizeable and replicable effects

on challenging behaviour. Finally, the utility of this methodology has been demonstrated; however, gaining greater efficiency would require further research and methodological development (e.g., variations of brief functional analysis, thinner functional analysis schedule).

In addition to methodological development, I made several other recommendations for future applied behavioural pharmacology research including: 1) exploring the relation between automatically-maintained challenging behaviour and medication manipulation. Namely, whether a specific sensory experience may impact how medication manipulation interacts with behaviour function, or behaviour change, and 2) exploring the relation between medication side effects and behaviour function. Overall, continuing to explore medication-behaviour interactions may serve to optimize treatment gains, and ultimately improve quality of life for individuals with ID.

References

Aman, M. G., Lam, K.S.L., & Collier-Crespin, A. (2003). Prevalence and patterns of use of psychoactive medicines among individual with autism in the autism society of Ohio, *Journal of Autism and Developmental Disabilities*, *33(5),* 527-534.

Aman, M. G., Lam, K. S. L., Van Bourgondien, M. E. (2005). Medication patterns in patients with autism: Temporal, regional, and demographic influences. *Journal of Child and Adolescent Psychopharmacology, 15, 116-126.* doi: 10.1089/cap.2005.15.116

Aman, M. G., Singh, N.H., Stewart, A.W., & Field, C.J. (1985). The Aberrant Behavior Checklist: Behavior Rating Scale for the Assessment of Treatment Effects. *American Journal of Mental Deficiency*, p 485-491.

Anderson, M. T., Vu, C., Derby, M., Goris, M. & McLaughlin, T.F. (2002). Using functional analysis procedures to monitor medication effects in an outpatient and school setting. *Psychology in the Schools, 39,* 73-76. doi: 10.1002/pits.10006

Armstrong, C.E. (1949). Moving averages. *The American Statistician, 3 (4),* 10.

Beavers, G., Iwata, B.A., & Lerman, D.C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46,* 1-21. doi: 10.1002/jaba.30

Berg, W.K., Peck, S., Wacker, D.P., Harding, J., McComas, J., Richman, D. & Brown, K. (2000). The effects of presession exposure to attention on the results of assessment of attention as a reinforcer. *Journal of Applied Behavior Analysis*, *33*, 463-477. doi: 10.1901/jaba.2000.33-463

Blum, N.H., Mauk, J.E., McComas, J.J., & Mace, F.C. (1996). Separate and combined effects of methylphenidate and a behavioral intervention of disruptive behaviour in children with

mental retardation. *Journal of Applied Behaviour Analysis*, *29*, 305-319. doi: 10.1901/jaba.1996.29-305

Breuning, S. E., & Davidson, N. A. (1981). Effects of psychotropic medications on intelligence test performance of institutionalized mentally retarded adults. *American journal of mental deficiency, 85(6),* 575-579.

Canadian Pharmacists Association (2013). Compendium of Pharmaceuticals and Specialties, online (e-CPS). Retrieved from https://www-e-therapeuticsca.proxy.library.brocku.ca/cps.showMonograph.action

Capriotti, M.R., Brandt, B.C., Ricketts, E.J., Espil, F.M., & Woods, D.W. (2012). Comparing the effects of differential reinforcement of other behaviour and response-cost contingencies on tics in youth with Tourette syndrome. *Journal of Applied Behaviour Analysis*, *45*, 251-263. doi: 10.1901/jaba.2012.45-251

Carlson, G., Pokrzywinski, J., Uran, K., & Valdovinos, M. (2012). The use of reinforcer assessment in evaluating psychotropic medication effects. *Journal of Developmental and Physical Disabilities, 24,* 515-528. doi: 10.1007/s10882-012-9282-4

Carr, J.E., Bailey, J.S., Ecott, C.L., Lucker, L. K.D., & Weil, T.M. (1988). On the effects of noncontingent delivery of differing magnitudes of reinforcement. *Journal of Applied Behavior Analysis*, *31*, 313-321. doi: 10.1901/jaba.1998.31-313

Carrick, R., Mitchell, A., Powell, R.A., & Lloyd, K. (2004). The quest for well-being: A qualitative study of the experience of taking antipsychotic medication. *Psychology and Psychotherapy: Theory, Research and Practice*, *77*, 19-33. doi: 10.1348/147608304322874236

Couppis, M.H., & Kennedy, C.H. (2008). The rewarding effect of aggression is reduced by nucleus accumbens dopamine receptor antagonism in mice. *Psychopharmacology*, *197*, 449-456. doi: 10.1007/s00213-007-1054-y

Couppis, M.H., Kennedy, C.H., & Stanwood, G.D. (2008). Differences in aggressive behaviour and in the mesocorticolimbic DA system between A/J and BALB/cJ Mice. *Synapse*, *62*, 715-724. doi: 10.1002/syn.20545

Cox, A. & Virues-Ortega, J. (in press). Interactions between behavior function and exposure to psychotropic medication. *Journal of Applied Behavior Analysis, XX(X), XX-XX.*

Crosland, K. A., Zarcone, J. R., Lindauer, S. E., Valdovinos, M.G., Zarcone, T. J., Hellings, J. A., & Schroeder, S.R. (2003). Use of a functional analysis methodology in the evaluation of medication effects. *Journal of Autism and Developmental Disorders*, *I*, 271-279. doi: 10.1023/A:1024402500425

Danov, S. E., Tervo, R., Meyers, S., & Symons, F.J. (2012). Using functional analysis methodology to evaluate the effects of an atypical antipsychotic on severe problem behaviour. *Journal of Mental Health Research*, *5*, 286-308. doi: 10.1080/19315864.2011.594976

Davidson, M., Cowie, S. & Elliffe, D. (2013). On the joint control of preference by time and reinforcer-ratio variation. *Behavioural Processes, 95,* 100-112. doi: 10.1016/j.beproc.2013.02.001

Derby, M. K., Wacker, D. P., Berg, W., DeRaad, A., Ulrich, S., Asmus, J., Harding, J., Prouty, A….Stoner, E. A. (1997). The long term effects of functional communication training in home settings. *Journal of Applied Behavior Analysis, 30(3),* 507-531.

Dews, P. B. (1964). A behavioral effect of amobarbital. Naunyn-Schmiedebergs Archiv für Experimentelle Pathologie und Pharmakologie, 248, 296-307. doi:10.1007/BF00246347

Felce, D., Lowe, K., Beecham, J. & Hallam, A. (2000). Exploring the relationships between costs and quality of services for adults with severe intellectual disabilities and the most severe challenging behaviours in Wales: A multivariate regression analysis. *Journal of Intellectual & Developmental Disability, 25(4)*, 307-326.

Firestone, P., & Marshall, W. L. (Eds.). (1999). Abnormal Psychology: Perspectives. Prentice Hall Allyn and Bacon Canada.

Fisher, W., Piazza, C.C., & Page, T.J. (1989). Assessing independent and interactive effects of behavioural and pharmacological interventions for a client with dual diagnosis. *Journal of Behaviour Therapy and Experimental Psychiatry, 20 (3),* 241-250.

Edrisinha, C., O'Reilly, M., Sigafoos, J., Lancioni, G. & Choi, H.Y. (2011). Influence of motivating operations and discriminative stimuli on challenging behaviour maintained by positive reinforcement. *Research in Developmental Disabilities, 32*, 836-845. doi: 10.1016/j.ridd.2010.10.006

Fowler, S. C. (1992). Force and duration of operant responses as dependent variables in behavioral pharmacology. In T. Thompson, P. B. Dews & J. E. Barrett (Eds.), *Neurobehavioral pharmacology* (pp. 83-128). Hillsdale, NJ: Erlbaum

Frazier, T.W., Youngstrom, E.A., Haycook, T., Sinoff, A., Dimitriou, F., Knapp, J., & Sinclair, L. (2010). Effectiveness of medication combined with intensive behavioural intervention for reducing aggression in youth with autism spectrum disorder. *Journal of Child and Adolescent Psychopharmacology*, 20, 167-177. doi: 10.1089/cap.2009.0048

Gagiano, C., Read, S., Thorpe, L., Eerdekens, M. & Van Hove, I. (2005). Short and long-term efficacy and safety of risperidone in adults with disruptive disorders. *Psychopharmacology, 179,* 629-636. doi: 10.1007/s00213-004-2093-2

Garcia, D., & Smith, R. G. (1999). Using analogue baselines to assess the effects of naltrexone on self-injurious behaviour. *Research in Developmental Disabilities, 20(1),*1-21.

Grey, I. M. & Hastings, R. P. (2005). Evidence-based practices in intellectual disability and behaviour disorders. *Current Opinion Psychiatry, 18:* 469-475. doi: 10.1097/01.yco.0000179482.54767.cf

Guy, W. (1976). ECDEU assessment manual for psychopharmacology, revised. Rockville, MD: US Department of Health, Education and Welfare.

Hagopian, L. P., Fisher, W. W., Thompson, R. H., & Owen-DeSchryver, J. (1997). Toward the development of structure criteria for interpretation of functional analysis data. *Journal of Applied Behavior Analysis, 30,* 313-326. doi: 10.1901/jaba.1997.30-313

Handen, B. L., Johnson, C. R., & Lubetsky, M. (2000). Efficacy of methylphenidate among children with autism and symptoms of attention-deficit hyperactivity disorder. *Journal of autism and developmental disorders, 30(3)*, 245-255.

Hayes, S. C., Barlow, D. H., & Nelson-Gray, R. O. (1999). The scientist practitioner: Research and accountability in the age of managed care . Allyn & Bacon.

Heyvaert, M., Mase, B., & Onghena, P. (2010). A meta-analysis of intervention effects on challenging behaviour among persons with intellectual disabilities. *Journal of Intellectual Disability Research, 54,* 634-649. doi: 10.1111/j.1365-2788.2010.01291.x

Hill, A. (1965). The environment and disease: Association or causation*? Proceedings of the Royal Society of Medicine, 58*, 295-300.

Hollander, E., Soorya, L., Chaplin, W., Anagnostou, E., Taylor, B. P., Ferretti, C. J., Wasserman, S…Settipani, C. (2012). A double-blind placebo-controlled trial of fluoxetine for repetitive behaviors and global severity in adult autism spectrum disorders. *American Journal of Psychiatry, 169,* 292-299. doi: 10.1176/appi.ajp.2011.10050764

Hayashi, Y., & Maze, M. (1993). Alpha2 adrenoceptor agonists and anaesthesia. *British Journal of Anaesthesia, 71(1),* 108-118.

Iwata, B,A., Dorsey, M.F., Slifer, K.J., Bauman, K.E., & Richman, G.S. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities, 2,* 3-20. doi: 10.1016/0270-4684(82)90003-9

Iwata, B.A., Dorsey, M.F., Slifer, K.J., Bauman, K.E., & Richman, S.G. (1994a). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, 27, 197-209. doi: 10.1901/jaba.1994.27-197

Iwata, B.A., Pace, G.M., Dorsey, M.F., Zarcone, J., Vollmer, T.R., Smith, R.G…Willis, K.D. (1994b). *The functions of self-injurious behaviour: An experimental-epidemiological analysis. Journal of Applied Behaviour Analysis, 27*, 215-240. doi: 10.1901/jaba.1994.27-215

Jaselskis, C. A., Cook, E. H., Fletcher, K., & Leventhal, B. I. (1992). Clonidine treatment of hyperactive children with autistic disorder. *Journal of Clinical Psychopharmacology, 12,* 322-327. doi: 10.1097/00004714-199210000-00005

Julien, E. M. (1995). *A primer of medication action: A concise, non-technical guide to the actions, uses, and side effects of psychoactive medications* (7th ed.). New York: W. H. Freeman and Company.

Kemble, E. D., Blanchard, D. C., & Blanchard, R. J. (1993). Methods in behavioral pharmacology: Measurement of aggression. In F. van Haaren (Ed.), Methods in behavioral pharmacology (pp. 539-559). Amsterdam: Elsevier.

Kennedy, C.H. & Meyer, K.A. (1996). Sleep deprivation, allergy symptoms, and negatively reinforced problem behavior. *Journal of Applied Behavior Analysis, 29,* 133-135. doi: 10.1901/jaba.1996.29-133

Kodak, T., Grow, L. & Northup, J. (2004). Functional analysis and treatment of elopement for a child with attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 37(2),* 229-232. doi:

Kress, G. (1985). Practical Techniques of Business Forecasting: Fundamentals and Applications for Marketing, Production, and Financial Managers. Quorum books.

Larsen, E.B., & Gerlach, J. (1996). Subjective experience of treatment, side effects, mental state and quality of life in chronic schizophrenic out-patients treated with depot neuroleptics. *Acta Psychiatrica Scandinavica*, 93(5), 381-388.

LaRue R.H., Northup, J., Baumeister, A.A., Hawkins, M.F., Seale, L., Williams, T., Ridgway, A. (2008). An evaluation of stimulant medication on the reinforcing effects of play. *Journal of Applied Behavior Analysis, 41,* 143-147. doi: 10.1901/jaba.2008.41-143

Lerman, & Iwata, B.A. (1996). A methodology for distinguishing between extinction and punishment effects associated with response blocking. *Journal of Applied Behavior Analysis, 29*, 231-233. doi: 10.1901/jaba.1996.29-231

Leyfer, O. T., Folstein, S. E., Bacalman, S., Davis, N. O., Dinh, E., Morgan, J…Lainhart, J. E. (2006). Comorbid psychiatric disorders in children with autism: Interview development

and rates of disorders. *Journal of Autism and Developmental Disorders, 36,* 849:861. doi: 10.1007/s10803-006-0123-0

Lord, C., & Paul, R. (1997). Language and communication in autism. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders, 2nd ed.* (pp. 195-225). New York: Wiley.

Mathews, M. & Muzina, D. J. (2007). Atypical antipsychotics: new medications, new challenges. *Cleveland Clinic Journal of Medicine*, *74*(8), 597-606.

Marcus, R.N., Owen, R., Kamen, L., Manos, G., McQuade, R.D., Carson, W.H. & Aman, M.G. (2009). A placebo-controlled, fixed-dose study of aripiprazole in children and adolescents with irritability associated with autistic disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 48,* 1110-1119. doi: 10.1097/CHI.0b013e3181b76658

Mazaleski, J. L., Iwata, B. A., Rodgers, T. A., Vollmer, T. R. & Zarcone, J. R. (1994). Protective equipment as treatment for stereotypic hand mouthing: Sensory extinction or punishment effects? *Journal of Applied Behavior Analysis, 27,* 345-355. doi: 10.1901/jaba.1994.27-345

McDougle, C. J., Kresch, L. E., Goodman, W. K., Naylor, S. T., Volkmar, F. R., Cohen, D. J. & Price, L. H. (1995). A case controlled study of repetitive thoughts and behavior in adults with autistic disorder and obsessive-compulsive disorder. *American Journal of Psychiatry, 152(5),* 772-777.

Michaels, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 57(1),* 149-155.

Miral, S., Gencer, O., Inal-Emiroglu, F., Baykara, B., Baykara, A., & Dirik, E. (2008). Risperidone versus haloperidol in children and adolescents with AD: A randomized, controlled, double-blind trial. *European Child and Adolescent Psychiatry,17,* 1-8. doi: 10.1007/s00787-007-0620-5

Myers, S. M. (2007). The status of pharmacotherapy for autism spectrum disorders. *Expert Opinion Pharmacotherapy, 8,* 1579:1603. doi: 10.1517/14656566.8.11.1579

Myrbakk, E., & von Tetzchner, S. (2008). The prevalence of behavior problems among people with intellectual disability living in community settings. *Journal of Mental Health Research in Intellectual Disabilities, 1,* 205-222. doi: 10.1080/19315860802115607

Newton, T.F., Ling, W., Kaleschstein, A.D., Uslaner, F., & Tervo, K. (2001). Risperidone pre-treatment reduces the euphoric effects of experimentally administered cocaine. *Psychiatry Research, 102,* 227-233. doi: 10.1016/S0165-1781(01)00255-4

Northup, J., Fusilier, I., Swanson, V., Huete, J., Bruce, T., Freeland, J., …Edwards, S. (1999). Further analysis of the separate and interactive effects of methylphenidate and common classroom contingencies. *Journal of Applied Behavior Analysis, 32*, 35-50. doi: 10.1901/jaba.1999.32-35

Northup, J., Fusilier, I., Swanson, V., Roane, H. & Borrero, J. (1997b). An evaluation of methylphenidate as a potential establishing operation for some common classroom reinforcers. *Journal of Applied Behavior Analysis, 30,* 615-625. doi: 10.1901/jaba.1997.30-615

Northup, J., Jones, J., Broussard, C., DiGiovanni, G., Herring, M., Fusilier, I., & Hanchey, A. (1997a). A preliminary analysis of interactive effects between common classroom

contingencies and methylphenidate. *Journal of Applied Behavior Analysis, 30*, 121-125. doi: 10.1901/jaba.1997.30-121

Northup, J., Wacker, D., Sasso G., Steege, M., Cigrand, K., Cook, J. & DeRaad, A. (1991). A brief functional analysis of aggressive and alternative behaviour in an outclinic setting. *Journal of Applied Behavior Analysis, 24,* 509-522. doi: 10.1901/jaba.1991.24-509

O'Reilly, M.F., & Lancioni, G. (2000). Response covariation of escape-maintained aberrant behaviour correlated with sleep deprivation. *Research in Developmental Disabilities, 21,* 125-136. doi: 10.1016/S0891-4222(00)00029-9

O'Reilly, M.F. (1995). Functional analysis and treatment of escape-maintained aggression correlated with sleep deprivation. *Journal of Applied Behavior Analysis, 28,* 225-226. doi: 10.1901/jaba.1995.28-225

O'Reilly, M.F. (1997). Functional analysis of episodic self-injury correlated with recurrent otitis media. *Journal of Applied Behavior Analysis, 30,* 165-167. doi: 10.1901/jaba.1997.30-165

Parker, R. I. & Hagan-Burke, S. (2007). Useful effect size interpretations for single-case research. *Behavior Therapy, 38,* p 95-105. doi: 10.1016/j.beth.2006.05.002

Pelham, W. E., Jr., Carlson, C., Sams, S.W., Vallano, G., Dixon, J., & Hoza, B. (1993). Separate and combined effects of methylphenidate and behaviour modification on boys with attention-deficit hyperactivity disorder in the classroom. *Journal of Consulting and Clinical Psychology, 61(3),* 506-515. doi:10.1037//0022-006X.61.3.506

Pelham, W.E. Jr., Gnagy, E.M., Greiner, A.R., Hoza, B., Hinshaw, S.P. Swanson, J.M.…McBurnett, K. (2000). Behavioral versus behavioural and pharmacological

functional treatment in ADHD children attending a summer treatment program. *Journal of Abnormal Child Psychology, 28(6),* 507-525.

Parmigiani, S., & Palanza, P. (1991). Fluprazine inhibits intermale attack and infanticide, but not predation, in male mice. *Neuroscience and Biobehavioral Research*, 15, 511-513

Poling, A. (2000). Variables that influence drug action. In A. Poling & T. Byrne (Eds.), *Introduction to behavioural pharmacology* (pp. 167–189). Reno, NV: Context Press.

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Virues-Ortega, J., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46,* 47-60. doi: 10.1002/jaba.26

Qureshi, H., & Alborz, A. (1992). Epidemiology of challenging behaviour. *Mental Handicap Research, 5(2)*, 130-145. doi: 10.1111/j.1468-3148.1992.tb00041.x

Reid, D. H., Parsons, M.B., & Green, C. W. (2012). Monitoring Staff Performance. *Supervisor's Guidebook: Evidence-based Strategies for Promoting Work Quality and Enjoyment Among Human Service Staff* (p. 81-108). Morganton, North Carolina, USA. Habilitative Managment Consultants.

Richman, D.M., & Hagopian, L.P. (1999). On the effects of "quality" of attention in the analysis of destructive behaviour. *Research in Developmental Disabilities, 20,* 51-62. doi: 10.1016/S0891-4222(98)00031-6

Rogers, A., Day, J.C., Williams, B., Randall, F., Wood, P., Healy, D. & Bentall, R.P. (1998). The meaning and management of neuroleptic medication: A study of patients with a diagnosis of schizophrenia. *Social Science and Medicine, 47(9),* 1313-1323.

Santosh, P. J., Baird, G., Pityaratstian, N., Tavare, E., & Gringras, P. (2006). Impact of comorbid autism spectrum disorders on stimulant response in children with attention deficit

hyperactivity disorder: A retrospective and prospective effectiveness study. *Child: care, health and development, 32*, 575-583. doi: 10.1111/j.1365-2214.2006.00631.x

Schultz, W., Dayan, P., & Montague, P.R. (1997). A neural substrate of prediction and reward. *Science, 275,* 1593-1599. doi: 10.1126/science.275.5306.1593

Scahill, L., McDougle, C.J., Aman, M.G., Johnson, C., Handen, B., Bearss, K.,…Vitiello, B. (2011). Effects of risperidone and parent training on adaptive functioning in children with pervasive developmental disorders and serious behavioural problems. *Journal of the American Academy of Child & Adolescent Psychiatry, 51,* 136-146. doi: 10.1016/j.jaac.2011.11.010

Seeman, P. (2005). Atypical antipsychotics: A mechanism of action. *Canadian Journal of Psychiatry, 47(1),* 27-38.

Sharma, A., & Shaw, S. R. (2012). Efficacy of risperidone in managing maladaptive behaviours for children with autistic spectrum disorder. Journal of Pediatric Health Care, 26, 291-299. doi:10.1016/j.pedhc.2011.02.008

Sideridis, G. D. (1997). Data smoothing: Prediction of human behavior, detection of behavioural patterns, and monitoring treatment effectiveness in single-subject behavioral studies. *Journal of Behavioral Education, 7,* 191-203. doi:1053-0819/97/0600-0191

Sidman, M. (1960). *Tactics of scientific research: Evaluating experimental data in psychology.* New York, USA: Basic Books Inc.

Smith, S. W., Hauben, M. & Aronson, J. K. (2012). Paradoxical and bidirectional medication effects. *Medication Safety, 35,* 173-189. doi: 10.2165/11597710-000000000-00000

Smith, R., Russo, G., & Le, D. (1999). Distinguishing between extinction and punishment effects of response blocking: A replication. *Journal of Applied Behavior Analysis, 32*, 367-370. doi: 10.1901/jaba.1999.32-367

Suri, R.E., Bargas, J. & Arbib, M.A. (2001). Modeling functions of striatal dopamine modulation in learning and planning. *Neuroscience, 103,* 65-82. doi:10.1016/S0306-4522(00)00554-6

Thomason-Sassi, J. L., Iwata, B. A., Neidert, P. L. & Roscoe, E. M. (2011). Response latency as an index of response strength during functional analyses of problem behaviour. *Journal of Applied Behavior Analysis, 44,* 51-67. doi: 10.1901/jaba.2011.44-51

Tiger, J.H., Hanley, G.P., & Bessette, K.K. (2006). Incorporating descriptive assessment results into the design of a functional analysis: A case example involving a preschooler's hand mouthing. *Education and treatment of children, 29(1),* 107-124.

Tsiouris, J. A., Kim, S-Y., Brown, W. T., Pettinger, J., & Cohen, I. L. (2013). Prevalence of psychotropic drug use in adults with intellectual disability: Positive and negative findings from a large scale study. Journal of Autism and Developmental Disorders, 43, 419-431. doi:10.1007/s10803-012-1617-6

Tyrer, P., Oliver-Africano, P.C., Ahmed, Z., Bouras, N., Cooray, S., Deb, S…Crawford, M (2008). Risperidone, haloperidol, and placebo in the treatment of aggressive challenging behaviour in patients with intellectual disability: A randomized controlled trial. *The Lancet*, *371*, 57-63.

Valdovinos, M.G., Ellringer, N.P., & Alexander, M.L (2007). Changes in the rate of problem behaviour with the discontinuation of the antipsychotic medication quetiapine. *Mental Health Aspects of Developmental Disabilities, 10(2)*, 64-67.

Valdovinos, M. G., & Kennedy, C. H. (2003). A behavior-analytic conceptualization of the side effects of psychotropic medication. The Behavior analyst/MABA, 27(2), 231-238.

Valdovinos, M.G., Nelson, S.M., Kuhle, J.L., & Dierks, A.M. (2009). Using analogue functional analysis to measure variations in problem behaviour rate and function after psychotropic medication changes: A clinical demonstration. *Journal of Mental Health Research in Intellectual Disabilities, 2,* 279-293. doi: 10.1080/19315860903104807

Van Haaren, F. & Weeden, M. (2013). Some guidelines for conducting research in applied behavioural pharmacology. *Journal of Applied Behavior Analysis, 46,* 498-506. doi: 10.1002/jaba.47

Wacker, D. P., Lee, J. F., Yantz, C., Dalmau, P., Kopelman, T. G., Lindgren, S. D…Waldron, D. B. (2013). Conducting functional analyses of problem behavior via telehealth. *Journal of Applied Behavior Analysis, 46,* 31-46. doi: 10.1002/jaba.29

Wallace, M. D., & Iwata, B. A. (1999). Effects of session duration on functional analysis outcomes. *Journal of Applied Behavior Analysis, 32,* 175-182. doi: 10.1901/jaba.1999.32-175

Ward, A. C. (2009). The role of causal criteria in causal inferences: Bradford Hill's "aspects of association". *Epidemiologic Perspectives & Innovations, 6(2).* Retrieved from http://archive.biomedcentral.com/content/pdf/1742-5573-6-2.pdf

Zarcone, J.R., Lindauer, S.E., Morse, P.S., Crosland, K.A., Valdovinos, M.G., McKerchar, T.L.,…Schroeder, S.R. (2004). Effects of risperidone on destructive behaviour of persons with developmental disabilities: III. Functional Analysis. *American Journal on Mental Retardation, 109,* 310-321. doi: 10.1352/0895-8017(2004)109<310:EORODB>2.0.CO;2

Zarevics, P., & Setler, P. E. (1979). Simultaneous rate-independent and rate-dependent assessment of intracranial self-stimulation: Evidence for the direct involvement of dopamine in brain reinforcement mechanisms. Brain research, 169(3), 499-512.

Appendix A

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Fax +204-269-7173

RENEWAL APPROVAL

April 15, 2014

TO: **Alison Cox**
Principal Investigator

FROM: [redacted]
Psychology/Sociology Research Ethics Board (PSREB)

Re: [redacted]
"Variations in Behaviour Function in Individuals Exposed to Atypical Antipsychotics"

Please be advised that your above-referenced protocol has received approval for renewal by the Psychology/Sociology Research Ethics Board. **This approval is valid for one year only.**

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Appendix B: Rate-dependency Simulation

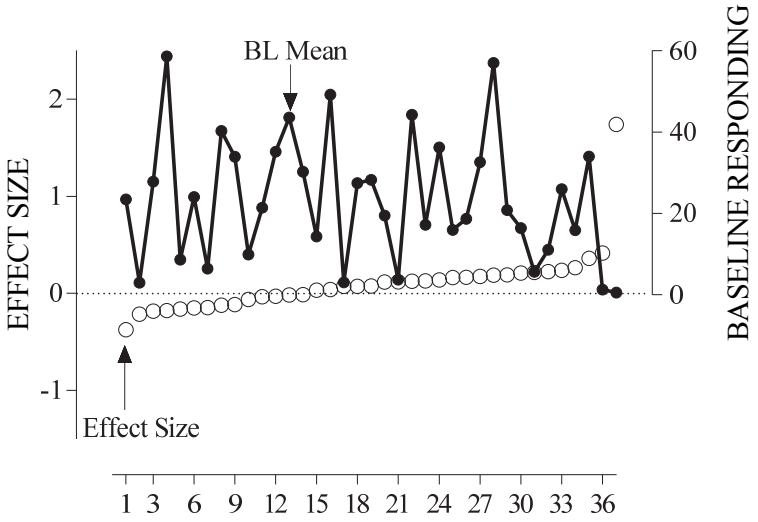

Figure A. Rate-dependency simulation with self-correlated data. Left y-axis represents standardized mean differences, or effect (open circles). Right y-axis represents mean baseline responding (rate per minute)(closed circles). Self-correlated random distribution generated, with 37 participants and 16 data points per functional analysis. Data distribution of baseline functional analyses set as random variation from 0 to a random number from 0 to 100. Cases are rank-ordered according to effect size.

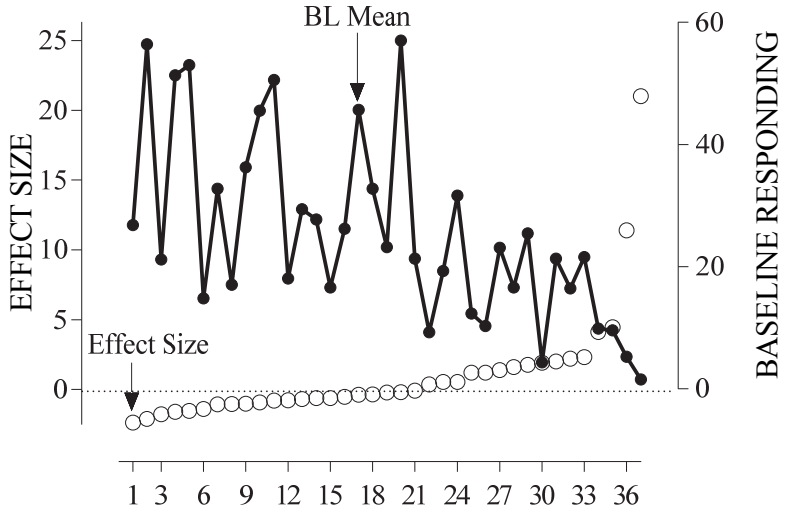

Figure B. Rate-dependency simulation with independent data. Left y-axis represents standardized mean differences, or effect (open circles). Right y-axis represents mean baseline responding (rate per minute)(closed circles). Independent random distribution generated, with 37 participants and 16 data points per functional analysis. Data distribution of baseline functional analyses set as random variation from 0 to a random number from 0 to 100. Cases are rank-ordered according to effect size.

Appendix C: Modified Function Assignment Criteria*

GENERAL CRITERIA**

1. D1 - Criterion for differentiation: 5 or more data points above the upper criterion line.
2. D2 - If play's lower criterion line is 0: 0s are counted as below the lower line.
3. D3 - If the play's upper criterion line is below 0.5: draw the upper criterion line at 0.5
4. [D4 - If there is no play condition and the highest condition is attention, demand or tangible (or any combination of these) assume 0 and 0.5 as LCL and UCL respectively]
5. [D5 - If the behaviour is measured with %INT the maximum UCL is 100%, any session with 100% responding will be considered above the UCL]
6. [D6 - If there are less than 10 data points per condition use absolute criteria proportionally, e.g., 50% of data points above UCL vs. 5 data points above UCL]

AUTOMATIC REINFORCEMENT CRITERIA

1. A1 - Alone is the highest and is significantly higher than play.
2. A2 - Behavior is higher in conditions with lower external stimuli (alone, att, tang) relative to conditions with higher external stimuli (play, demand).
3. A3 - All conditions are high and relatively stable with no overall trends (mean of all conditions is above 1.5 per min and less than 5 zero points)

TRENDS

1. T1 - CONDITION DOWNWARD (undifferentiated): If less than two data points above the upper CL occur in the second half of the assessment. This rule does not apply to demand and tangible if responding adapts to an efficient rate (e.g., every 30 s in demand)
2. T2 - CONDITION UPWARD (differentiated): All 5 data points above the upper CL are in the second half of the assessment, ignore points below the lower CL
3. T3 - OVERALL TREND (differentiated): condition that is consistently higher than play.

LOW RATE BEHAVIOR

1. LR1 - Most of the data points are low across all conditions [100-(1/number conditions*100)]** AND More than half of the high sessions occur in a test condition AND More than half of the behaviours occur in the same condition as #2 AND At least one of the high points in the condition identified in #2 should occur in the second half of the assessment

LOW MAGNITUDE EFFECT

1. LM1 - Condition meets criterion for differentiation (D1) by a small amount -- > raise CL by 20%. LM1 can be used only if T2 is not applicable.

MULTIPLE

1. M1 - Multiple meet criterion for differentiation and alone is not the highest
2. M2 - If three conditions are differentiated and alone is not the highest, ignore automatic
3. M3 - Two differentiated conditions and alone is the lowest --> it will be multiple (alone and the other)

*The modified criteria are adapted from Hagopian et al. (1997). Square brackets are additional items added by Cox and Virues-Ortega (in press).
**Upper and lower criterion line: SD above and below the mean of the play condition.

Appendix D: Application of Modified Criteria Across Medication Phases

Participant 1

Topography: Grabbing
Assessment: Risperidone 0.5 mg

Criterion lines

UCL:	0.5
LCL:	0.0

Summary of criteria

Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	LR1, T3
Other criteria:	D3, D6
Outcome:	Social negative Reinf.

Note. Unless otherwise indicated, the basis for evaluating a condition as undifferentiated is failure to meet D1.

Assessment: Risperidone 0.25 mg

Criterion lines

UCL:	0.5
LCL:	0.0

Summary of criteria

Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	T3
Other criteria:	D3, D6
Outcome:	Social negative reinf.

Assessment: Risperidone 0.5 mg

Criterion lines

UCL:	0.5
LCL:	0.0

Summary of criteria

Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	T3
Other criteria:	D3
Outcome:	Social negative reinf.

Appendix D *(cont'd)*
Participant 2

Topography: Head Hitting
Assessment: Risperidone 3 mg

Criterion lines

UCL:	29.5
LCL:	6.7

Summary of criteria

Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	D1
Social negative reinf. (demand):	Undifferentiated
Other criteria:	M3
Outcome:	Multiply controlled; Automatic reinf. and social positive reinf.

Assessment: Fluoxetine 20 mg + Risperidone 3 mg

Criterion lines

UCL:	19.7
LCL:	6.2

Summary of criteria

Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	D1
Social negative reinf. (demand):	Undifferentiated
Other criteria:	M3
Outcome:	Multiply controlled; Automatic reinf. and social positive reinf.

Assessment: Risperidone 3 mg

Criterion lines

UCL:	20.1
LCL:	1.4

Summary of criteria

Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	
Outcome:	Undifferentiated

Appendix D *(cont'd)*
Participant 8

Topography: Grabbing
Assessment: Background Medication

Criterion lines	
UCL:	5.0
LCL:	1.6
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	D6
Outcome:	Undifferentiated

Assessment: Discontinue Clonidine

Criterion lines	
UCL:	3.1
LCL:	0.0
Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	
Outcome:	Automatic reinf.

Assessment: Risperidone 0.5 mg

Criterion lines	
UCL:	1.0
LCL:	0.1
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	D6
Outcome:	Undifferentiated

Assessment: Risperidone 1 mg

Criterion lines	
UCL:	2.3
LCL:	0
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	
Outcome:	Undifferentiated

Appendix D *(cont'd)*
Participant 8

Topography: Table Swiping
Assessment: Background Medication

Criterion lines	
UCL:	4.3
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	D6
Outcome:	Undifferentiated

Assessment: Reduced Clonidine

Criterion lines	
UCL:	2.1
LCL:	0.0
Summary of criteria	
Automatic reinf. (Ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	
Outcome:	Undifferentiated

Assessment: Discontinue Methylphenida

Criterion Lines:	
UCL:	0.5
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	LR1
Other criteria:	D3, D6
Outcome:	Social negative reinf.

Appendix D *(cont'd)*
Participant 8

Topography: Table Swiping
Assessment: Discontinue Clonidine

Criterion Lines:	
UCL:	1.8
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	D1
Other criteria:	
Outcome:	Social negative reinf.

Assessment: Risperidone 0.5 mg

Criterion Lines:	
UCL:	0.5
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	D3, D6
Outcome:	Undifferentiated

Assessment: Risperidone 1 mg

Criterion Lines:	
UCL:	0.5
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other criteria:	D3
Outcome:	Undifferentiated

Appendix D *(cont'd)*
Participant 10

Topography: Hair Pulling
Assessment: Baseline

Querim et al., (2013) conducted a series of 5-min alone (or no-interaction) probes for 30 cases of challenging behaviour to examine the utility of providing brief exposure to alone or no-interaction sessions as a screening measuring for automatically-maintained challenging behaviour. The screening assessment outcomes were compared to fully complete functional analyses to evaluate the predictive capacity of the former. The authors concluded that the screening procedure accurately predicted the function of challenging behaviour (social vs. automatic) in 28 out of 30 datasets.

Outcome:	Automatic reinf.

Assessment: Aripiprazole 2.5 mg

Criterion Line:	
UCL:	0.5
LCL:	0.0
Summary of criteria:	
Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other Criteria:	D3, D6
Outcome:	Automatic reinf.

Assessment: Aripiprazole 5 mg

Criterion Line:	
UCL:	2.9
LCL:	0.0
Summary of criteria	
Automatic reinf. (ignore):	D1, A1
Social positive reinf. (attention):	Undifferentiated
Social negative reinf. (demand):	Undifferentiated
Other Criteria:	D6
Outcome:	Automatic reinf.

Assessment: Aripiprazole 7.5 mg

Criterion Line:	
UCL:	2.3
LCL:	0.3
Summary of criteria:	
Automatic reinf. (ignore):	Undifferentiated
Social positive reinf. (attention):	D1
Social negative reinf. (demand):	Undifferentiated
Other Criteria:	D6
Outcome:	Social positive reinf.

Appendix D *(cont'd)*
Participant 10

Topography: Skin Picking
Assessment: Baseline & Aripiprazole 2.5 mg

Querim et al., (2013) conducted a series of 5-min alone (or no-interaction) probes for 30 cases of challenging behaviour to examine the utility of providing brief exposure to alone or no-interaction sessions as a screening measuring for automatically-maintained challenging behaviour. The screening assessment outcomes were compared to fully complete functional analyses to evaluate the predictive capacity of the former. The authors concluded that the screening procedure accurately predicted the function of challenging behaviour (social vs. automatic) in 28 out of 30 datasets.

Outcome Baseline:	Automatic reinf.
Outcome Aripiprazole 2.5 mg	Automatic reinf.

Assessment: Aripiprazole 5 mg

Criterion Line:	
UCL:	27.0
LCL:	0.0
Summary of criteria:	
Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	D1, T1
Social negative reinf. (demand):	Undifferentiated
Other Criteria:	
Outcome:	Automatic reinf.

Note: T1 criteria was applied to the last third of the graph, where a downward trend becomes apparent

Assessment: Aripiprazole 7.5 mg

Criterion Line:	
UCL:	17.8
LCL:	0.2
Summary of criteria:	
Automatic reinf. (ignore):	D1
Social positive reinf. (attention):	D1
Social negative reinf. (demand):	D1
Other Criteria:	M2
Outcome:	Mult. Controlled; Social negative and social positive reinf.

Appendix D *(cont'd)*
Participant 10
Topography: Hand Biting
Assessment: Background Medication

Criterion Lines:
UCL: 0.5
LCL: 0.0
Summary of criteria
Automatic reinf. (ignore): Undifferentiated
Social positive reinf. (attention): Undifferentiated
Social negative reinf. (demand): Undifferentiated
Other criteria: D3, D6
Outcome: Undifferentiated

Assessment: Aripiprazole 2.5 mg

Criterion Lines:
UCL: 0.5
LCL: 0.0
Summary of criteria
Automatic reinf. (ignore): Undifferentiated
Social positive reinf. (attention): Undifferentiated
Social negative reinf. (demand): Undifferentiated
Other criteria: D3, D6
Outcome: Undifferentiated

Assessment: Aripiprazole 5 mg

Criterion Lines:
UCL: 0.5
LCL: 0.0
Summary of criteria
Automatic reinf. (Ignore): Undifferentiated
Social positive reinf. (reprimand): Undifferentiated
Social negative reinf. (time-out): Undifferentiated
Other criteria: D3
Outcome: Undifferentiated

Assessment: Aripiprazole 7.5 mg

Criterion Line:
UCL: 0.5
LCL: 0.0
Summary of criteria:
Automatic reinf. (ignore): Undifferentiated
Social positive reinf. (attention): Undifferentiated
Social negative reinf. (demand): Undifferentiated
Other criteria: D3
Outcome: Undifferentiated

Appendix E: Summary Table of Function-Specific and Overall Medication Effects Across Participant Datasets

Summary of Medication Effects Across P1, P2, and P8.

	Medication	Comparison			Function-Specific Effects			Overall Effects		
		1	2	3	1-2	2-3	1-3	1-2	2-3	1-3
P1	Risperidone	0.25 mg	0.50 mg	0.25 mg	C-Esc	C-Esc	C-Esc	Inc	Dec	Und
P2	Fluoxetine	0 mg	20 mg	0 mg	C-Mul	S-Und	S-Und	Dec	Dec	Dec
	Risperidone	3 mg	3 mg	3 mg	-	-	-	-	-	-
P8-G (a)	Clonidine	0.1 mg	0 mg	-	S-Aut	-	-	NC	-	-
	Risperidone	1 mg	1 mg	-	-	-	-	-	-	-
P8-G (b)	Risperidone	1 mg	0.5 mg	1 mg	S-Und	C-Und	S-Aut	Dec	Inc	Dec
P8-TS (a)	Methylphenidate	15 mg	15 mg	0	-	S-Esc	S-Esc	-	Dec	Dec
	Clonidine	0.2 mg	0.1 mg	0.1 mg	C-Und	-	-	NC	-	-
	Risperidone	1 mg	1 mg	1 mg	-	-	-	-	-	-

(continued)

	Medication	Comparison			Function-Specific Effects			Overall Effects		
		1	2	3	1-2	2-3	1-3	1-2	2-3	1-3
P8-TS (b)	Risperidone	1 mg	0.5 mg	1 mg	S-Und	C-Und	S-Und	Dec	NC	Dec
	Clonidine	0 mg	0 mg	0 mg	-	-	-	-	-	-

Note. Att = Attention-maintained behaviour; Aut = Automatic-maintained behaviour; C = Correspondence; Dec = Overall decrements in behaviour; Esc = Escape-maintained behaviour; G-Grabbing; Inc = Overall increments in behaviour; Mul = Multiply-controlled behaviour; NC = No change; S = Function-specific effect; TS – Table swiping; Und = Undifferentiated outcome.

Appendix E *(cont'd)*

Summary of Medication Effects Across P10 Topographies.

	Medication	Comparison				Overall Effects					
		1	2	3	4	1-2	2-3	1-3	1-4	2-4	3-4
P10-HB	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	NC	NC	NC	NC	NC	NC
P10-HP	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	Dec	Inc	NC	Dec	Inc	NC

(continued)

	Medication	Comparison				Overall Effects					
		1	2	3	4	1-2	2-3	1-3	1-4	2-4	3-4
P10-SP	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	NC	NC	NC	NC	NC	NC

Note. Att = Attention-maintained behaviour; Aut = Automatic-maintained behaviour; C = Correspondence; Dec = Overall decrements in behaviour; Esc = Escape-maintained behaviour; HB – Hand biting; HP = Hair pulling; Inc = Overall increments in behaviour; Mul = Multiply-controlled behaviour; NC = No change; S = Function-specific effect; SP- Skin picking; Und = Undifferentiated outcome.

Appendix E *(cont'd)*

Summary of Function-Specific Medication Effects Across P10 Topographies.

	Medication	Comparison				Function-Specific Effects					
		1	2	3	4	1-2	2-3	1-3	1-4	2-4	3-4
P10-HP	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	C -Aut	C -Aut	C-Aut	S-Att	S-Att	S-Att
P10 - SP	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	C -Aut	C -Aut	C-Aut	S-A/E	S-A/E	S-A/E

(continued)

	Medication	Comparison				Function-Specific Effects					
		1	2	3	4	1-2	2-3	1-3	1-4	2-4	3-4
P10-HB	Risperidone	3 mg	3 mg	3 mg	3 mg	-	-	-	-	-	-
	Concerta	54 mg	54 mg	54 mg	54 mg	-	-	-	-	-	-
	Methylphenidate	10 mg	10 mg	10 mg	10 mg	-	-	-	-	-	-
	Fluoxetine	40 mg	40 mg	40 mg	40 mg	-	-	-	-	-	-
	Trazodone	15 mg	15 mg	15 mg	15 mg	-	-	-	-	-	-
	Aripiprazole	0 mg	2.5 mg	5 mg	7.5 mg	C -Und	C -Und	C-Und	C-Und	C-Und	C-Und

Note. A = Attention-maintained behaviour; Att = Attention-maintained behaviour; Aut = Automatic-maintained behaviour; C = Correspondence; Dec = Overall decrements in behaviour; E = Escape-maintained behaviour; Esc = Escape-maintained behaviour; HB – Hand biting; HP – Hair pulling; Inc = Overall increments in behaviour; Mul = Multiply-controlled behaviour; NC = No change; S = Function-specific effect; SP – Skin picking; Und = Undifferentiated outcome.

Appendix F: Project Description and Consent to Participation Form for Parents/Legal Guardians

Alison Cox
PhD Candidate
P216 Duff Roblin Bldg

Feel free to call us or

email us anytime if you

Research Project Title: *Variations in Behaviour Function in Individuals Exposed to Psychotropic Medication*

Researchers: Dr. Javier Virues-Ortega, Alison Cox

Affiliations: Children's Care and the Department of Psychology, University of Manitoba

This description, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what participation will involve. If you would like more detail about something mentioned here, or information not included here please feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

What is the purpose of the project?

Our goal is to determine the relationship between psychotropic medication dosages (e.g., risperidone, carbamazepine, abilify) and the frequency of certain problem behaviours.

Specifically, I will:

1.) Measure how often an individual engages in challenging behaviors through a behavioural assessment called, a **functional analysis.**

2.) Measure how often an individual engages in challenging behaviours immediately before and immediately after a dosage change has been instituted

Participants include persons with Intellectual Disabilities (ID). This approach may be highly beneficial in that the information gleaned from this study could inform future treatment decisions; not only for the participants themselves but also for others presenting with challenging behaviours and ID.

How is the study organized and how long will the project take?

This project will include several assessment sessions throughout the duration of the study. Direct behavioural assessments (i.e., functional analysis) will be conducted once per week for the duration of the study. Each time a psychotropic medication change is made, staff will be asked to complete a 15 minute questionnaire regarding the participant's behaviour. The study will continue until at least three medication changes have occurred, as per the psychiatric teams'

recommendations. The researcher team will not be involved in the psychiatric process at all. Depending on how often medication changes are made, participation could last anywhere from six to nine months.

What is a functional analysis?

The conditions included in a functional analysis are called: 1.) alone, 2.) demand, 3.) activities (play), and 4.) attention. During the alone condition, no research assistant (RA) or materials are required. Rather the individual is provided time with no one in the room with them and no items to engage with for up to 10 minutes. Research assistants would record the frequency of challenging behaviours that occur during this condition. If resources are not available (e.g., a room with a one-way mirror) then the RA would sit in the room with the individual but not engage with them for the duration of the session. This condition assesses whether the challenging behaviours are the result of automatic reinforcement, meaning the participant does not require external items or persons to be motivated to continue to engage in the behaviour. During the demand condition, where the purpose is to assess whether the individual engages in challenging behaviour to escape a request/demand, the RA begins that session by presenting a relevant task demand (educational, vocational, self-care etc.). If the individual does not comply with 5 seconds of the demand being placed, the RA then demonstrates the correct response. If the individual does not follow the instruction within 5 seconds of being provided the model, the RA then provides gentle physical guidance to support them in completing the task. If the individual engages in challenging behaviour at any time during the session, the materials are removed and the research assistant turns away for 30 seconds (providing escape from the task). During the activities (play) condition, the individual is provided with free access to preferred items, and the RA engages in brief conversation with the individual every 30 sec. No consequences are provided for challenging behaviours. During the attention condition, which assesses whether the individual engages in challenging behaviour to get attention from others, the room will contain some preferred items (e.g., leisure items) that are freely available during the session. The session begins when the RA tells the participant that they are "going to do some work" and proceeds to "mark a paper", "read a book". The individual is permitted to engage with the items at their leisure, the RA will not interact with the individual unless they begin to engage in challenging behaviour. Upon the occurrence of challenging behaviour, the RA will provide a brief statement of concern (e.g., "you will hurt yourself, please stop; you will hurt me, please stop) and then return to work. This will continue until the session is timed out.

Are there any restrictions for those wishing to take part in this study?

Persons who have an untreated medical condition or have had a seizure in the last year are not eligible to participate.

What Information will be obtained from Children's Care?

I will require your permission to contact Children's Care and/or the consulting Psychiatrist to obtain the following information:

1.) Diagnosis information, if available.

2.) Current psychotropic medication prescription and any follow up changes for the duration of the study (e.g., dosage level changes; termination of medication; initiation of medication, medication administration recording sheets)

    a. Information regarding non-psychiatric medication changes will also be requested, in order to fully examine the influence of psychotropic medication changes on the factors that motivate the participant to engage in problem behaviour.

Will the participant's personal information be kept confidential?

All information obtained about the participants' will be handled in compliance with the Personal Health Information Act (PHIA). All information will be kept confidential and stored in a locked office. Only the research staff directly involved in the study will have access. Participants will not be identified by name on recording forms and devices (e.g., a code number will be assigned). Any presentation, reports, or publications about the project will not contain any identifying information.

Any video that is recorded by designated research assistants during the assessment sessions will not be duplicated and only be used for study purposes (e.g., conducting inter-rater reliability). Only the primary investigator and Dr. Virues-Ortega will have access to the video, which will be kept in a locked filing cabinet in a locked office at St. Amant Research Center. The videos will be destroyed within three months of study completion. Identifying information and the "key" linking the participant to the results will be kept for up to five years following the completion of the project. Both the key and the data will then be destroyed in a confidential manner. However, an option is available at the end of this document for you to give us permission to retain the video for use in future studies. If you grant us permission in this document to retain the participants' data for future studies, you will receive a phone call in the future about the specific study I would like to use the data for. There will be a separate informed consent process at that time. You can choose to decline participation in the future study at any time.

Despite efforts to keep your personal information confidential, absolute confidentiality cannot be guaranteed. Your personal information may be disclosed if required by law. When a participant's life, health or emotional well-being is put at risk by something a person does or fails to do, that participant is in need of protection. Abuse may be any action (or failure to act) causing a physical injury that could cause a permanent emotional disability or involves sexual activity.

What will happen if my loved one becomes distressed during the assessment?

Every precaution will be taken to ensure the safety of the participant and the research assistant. If the participant begins to escalate to the point where they present an immediate risk to themselves or others, the session will be terminated. There will always be two highly trained research assistants conducting the assessment sessions. Both will have training in Professional Crisis Management should the need to intervene arise. However, I do not foresee any risks for the participants' beyond what might be normally encountered in everyday situations.

What are the risks and benefits of taking part in the project?

The study will involve minimal risk. A report of the assessment results will be emailed or mailed to you at the end of the study. With your permission, these results can be shared with qualified professionals currently working with your loved one, which they may use to inform and improve ongoing treatment strategies. In addition, the results from this study may be useful in suggesting intervention strategies for individuals with ID and challenging behaviours not directly part of the study.

Is there any cost for participating?

There is no payment or cost for participating.

Is participation voluntary?

Participation is voluntary. Any services you or your loved one are receiving from either the University of Manitoba or Children's Care currently or in the future will not be affected by your choice to give consent for your loved one to participate in this this project. Moreover, even after you have given consent, you can stop any time and for any reason by simply calling the researchers listed at the end of the consent form. Your decisions to stop will not affect any services you or your loved one may be receiving now or in the future from Children's Care or the University of Manitoba. Lastly, the cooperation of your loved one to participate in this project will be monitored throughout the project. If they wish to stop during an assessment, that decision will be respected.

Will I be contacted in the future for other studies?

The result of this research may lead to other related studies in the future that may be beneficial to your loved one. Please check YES in the appropriate box at the end of this form if you would like to be contacted directly by the researchers in the future about other studies.

Signing the Consent Forms

Signing the following pages of this *Project Description and Consent Form* indicates that you have understood to your satisfaction the information regarding participation in the research project and agree for your loved one to take part as a participant. In no way does this waive your legal rights nor release your researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the project at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.
Project Director: Alison Cox:

The Psychology/Sociology Research Ethics Board has approved this research. If you have any concerns or complaints about this project, you may contact any of the above-named person or the Human Ethics Secretariat at 204- 474-7122. A copy of this Project Description and Consent Form has been given to you to keep for your records and reference.

Consent to Contact Information Slip

<u>This is not a consent form.</u> Return this form only if you are giving permission just to be contacted to receive more information.

Project title: Variations in Behaviour Function in Individuals Exposed to Psychotropic Medication

I would like more information. Please contact me at the contact information below.

Email: _____

Phone 1: _____ □ Cell □ Land line

Phone 2: _____ □ Cell □ Land line

Best time:_____

Postal Code: _____

_____ _____

Please print your name Signature

Please return the completed form preferably by email.
You could also use the enclosed stamped envelope or <u>phone us to pick it up</u>.

Return to:

Alison Cox, BCBA
Primary Investigator

If you have any questions please feel free to phone or email

Release Information Form

I, _____ (print your name) hereby consent to _____'s (print participants' name) participation in the project, entitled "*Variations in Behaviour Functions in Individuals Exposed to Psychotropic Medication"*.

By giving consent I allow the research project staff to:

- Access diagnosis information from St. Amant regarding my loved one
- Conduct functional analyses at St. Amant
- Include the participant's results in publications, reports, and talks, so that others may learn from this project. The identity of the participant, however, will not be disclosed.

I understand that I can revoke or amend this consent at any time for any reason.

Please check YES or NO for the following items:	**YES / NO**	
I would like to receive the results of this project after it is completed. I would prefer that the researchers contact me by (check): □Mail □Email □Phone	☐	☐
I give permission for the researchers to retain my data, but without my personal identifying information (identifying inform tion will be destroyed 5 years after the completion of the study). If you check NO, both data and identifying information will be destroyed after 5 years).	☐	☐
I give permission for the researchers to contact Children's Care programs and the consulting p ychiatrist that my loved one receives services from to request specific information relevant to this project (i.e., diagnosis, current prescriptions, Medication Administration Record Sheets (MARS))	☐	☐
I give permission for research sessions to be vid otaped for study purpo es only (e.g., conducting interobserver agreement)	☐	☐
The researchers may contact me directly for possible future related studies.	☐	☐

Mailing Address: _____

Email: _____

Phone 1: _____ **Preferable hours:**_____

Phone 2: _____

_____	_____	_____	_____
Name of consent giver	Relationship to participant	Signature of consent giver	Date

_____	_____	_____
Name of researcher/delegate	Signature of researcher/delegate	Date